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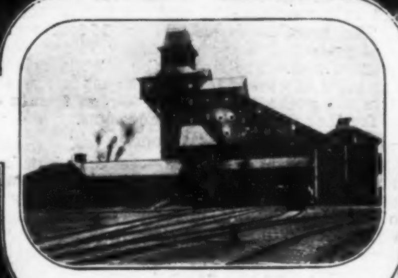
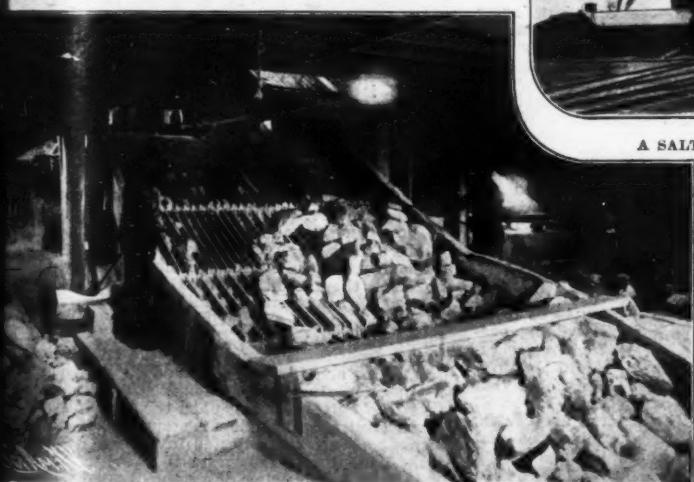
CARS AT THE FOOT OF THE SHAFT (1,250 FEET UNDERGROUND) READY TO BE HOISTED TO THE SURFACE.

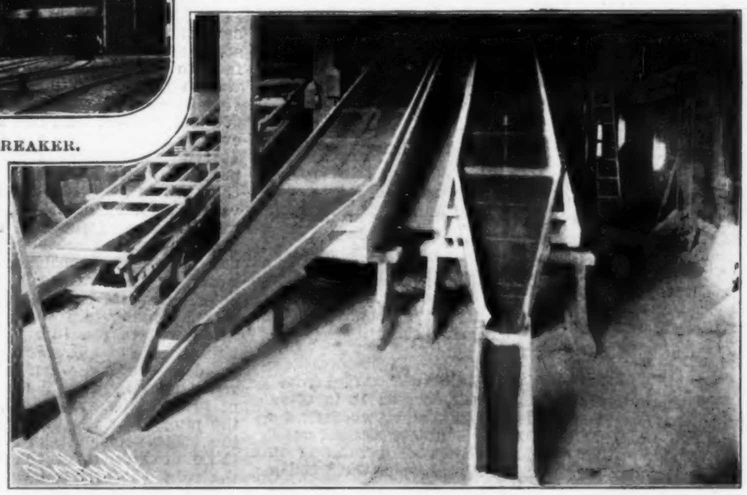
DRILLING HOLES FOR DYNAMITE CHARGES IN A SALT MINE.



A SALT BREAKER.



HEAD HOUSE IN BREAKER, SHOWING "TIPPLERS" ON WHICH THE SALT IS FIRST DUMPED FROM THE CARS, PASSING OVER THE BARS AND INTO THE CRUSHERS.



SCREENS USED FOR SEPARATING CRUSHED SALT INTO THE DIFFERENT SIZES REQUIRED IN COMMERCE.

A MULE AND CAR IN ONE OF THE SALT TUNNELS, 1,250 FEET BELOW THE SURFACE.

THE MINING AND MANUFACTURE OF ROCK SALT IN NEW YORK STATE.

MINING AND MANUFACTURE OF ROCK-SALT.

The mining of rock-salt is briefly described by Dr. F. E. Englehardt,* as follows:

Rock-salt mining in the State of New York dates from November, 1885, when the first shaft belonging to the Retsof Mining Company, situated near Piffard, Livingston County, reached the underlying salt bed. Since then a second shaft has been sunk about two miles south of Le Roy, in Genesee County, by the Lehigh Salt Mining Company. A third one has been sunk at Livonia, Livingston County, and a fourth one is just finished at Greigsville, in the same county, about two miles west of the Retsof shaft.

The sinking of the shafts is done in the usual manner. The sides are protected from caving in by heavy timbers, and to prevent water from entering the shaft a heavy layer of cement is put between the walls of the shaft and the timber. The size of the shafts varies somewhat; the usual dimensions are 12 feet by 18 feet to 24 feet square in the clear. The main galleries are about 30 feet wide, their height depending on the thickness of the salt beds. Some salt must always be left as a roof and floor; hence, in a vein of salt 24 feet thick, an allowance of 6 feet for the roof and 4 feet for the floor would give a gallery or chamber 14 feet in height. From the main chambers cross sections or galleries are run every 30 feet; thus the roof above is supported by pillars 30 feet square. The salt is blasted out with dynamite. The drills are run by compressed air about 6 feet into the solid salt, and they are set in such a manner that when the blast takes place as much as possible of the salt remains in lumps. The salt is loaded into small cars, which are run on tracks laid on the floors of the chambers onto cages in the shaft through which they are carried or hoisted to the top of the breakers, similar to those used in coal mining, and from 100 to 145 feet above the surface of the ground. To separate the lump salt from the finer material the contents of the cars are dumped on a set of iron bars, which permit all the salt to fall through into the crusher below except the lumps, which are loaded onto other cars and run down an incline to the ground, where they are stored, usually in the open air, for shipment. The finer material passes through the crushers onto sieves and from the latter into the bins. Of the crushed and sifted salt there are four kinds, according to size. The lump salt is mainly used for stock, the other grades for the same purposes for which sea or solar salt is used.

The quality of the mine salt may be learned from the following analysis of an average sample (A) and perfectly white salt (B).

	A	B
Moisture	a trace	a trace
Insoluble	0.7430 per ct.	0.0584 per ct.
Sulphate of lime (calcium sulphate).	0.4838 per ct.	0.0793 per ct.
Calcium chloride	0.0180 per ct.	0.0358 per ct.
Magnesium chloride ..	0.0546 per ct.	0.0888 per ct.
Pure salt	98.7006 per ct.	99.7410 per ct.

The Manufacture of Salt in the State of New York.

BY F. E. ENGLEHARDT, PH. D.

The processes employed to-day in the manufacture of salt in the State of New York are as follows:

1. Solar evaporation.
2. Direct fire evaporation. { Pan process. Kettle process.
3. Steam evaporation. { Kettle with steam jacket. Grainer process.
4. Vacuum pan evaporation.

I. Solar Evaporation.

The manufacture of solar salt, or, as it is often called, coarse salt, is carried on in shallow wooden vats which, in order to protect the contents against rain, are provided with movable wooden covers, running on wooden rollers. At the end of the season the wooden rollers are removed and the covers or roofs fastened securely on the vats.

There are three sets of these vats, or, as they are more familiarly called, "rooms." The first are called "deep rooms," and serve for the reception of the brine as it comes from the wells or pump-house. The brine when received in these rooms is usually perfectly clear, but soon it becomes turbid and of a yellowish red color. This change is due to the escape of carbonic acid gas, with which the brine is highly charged when it comes from the wells, and by which the trace of ferrous carbonate present is held in solution. The solvent escaping, the ferrous oxide takes up oxygen and separates from the brine as a hydrated ferric oxide in a very finely divided state, causing a yellowish turbidity, which disappears gradually as the ferric oxide settles to the bottom of the vat, and leaves the brine clear again. The deep rooms are constructed higher above the ground than the following set, which are called "lime rooms" (this is a misnomer, since in the manufacture of solar salt lime is never used), in order to enable the workmen to draw from them into the lime rooms as occasion requires. The evaporation of water from the brine, which commences in the deep rooms, continues in the lime rooms till the brine reaches its point of saturation, which is recognized by the workman when small cubic salt crystals make their appearance. While the brine is evaporating and becoming saturated, a second change takes place in it, namely, a certain amount of sulphate of lime or gypsum separates from it in beautiful crystals on the sides and bottom of the room. This separation is especially marked when the brine is near its point of saturation. The now fully saturated brine is called pickle and is drawn into the third or lowest set of rooms, called the salt rooms. Here another change takes place. Salt and a portion of the remaining sulphate of lime crystallize out, the former in more or less perfectly developed cubic crystals, the latter in fine, slender crystals, often twinned. As the evaporation of the water from the pickle progresses, the salt crystals first formed increase in size, new ones make their appearance, and soon the entire bottom of the room is covered with them. It is the custom of the manufacturer, while this is going on, to introduce a sufficient amount of saturated pickle from the lime rooms to replace the evaporated water and thus keep the salt well covered.

Whenever a sufficient amount of salt has accumulated in the salt rooms, it is harvested. This occurs about three times during a season. The process consists in raking it together on the side of the room next to the road and putting it into small perforated tubs, to drain off as well as possible the adhering calcium and magnesium chlorides, since they impart to the salt a sharp, bitter taste and keep it from becoming properly dry, as they are very deliquescent, absorbing moisture rapidly from the air. This being accomplished, the salt is dumped into the salt cart and drawn to the storehouse. Since the gathered salt consists of crystals of various sizes, many manufacturers pass it, as it comes from the salt yard (the name given to these works) into the storehouse, over a wire screen with 2½ meshes to the square inch, kept in motion by hand or steam power. While the unscreened salt is called "standard coarse," that which passes over the screen is known as "diamond C," and the portion passing through the meshes "diamond F."

Of the three kinds of rooms belonging to a salt yard, about one-third are deep and lime rooms; the rest are salt rooms. These rooms are usually 18 feet wide; their length depends often on the exent of the yard, and it may be therefore from 100 to 500 feet and more. In a properly constructed salt yard, where the salt rooms are of great length, they are built in a number of sections in such a manner that the floor of the first one is some 6 or 8 inches higher than that of the next one, and the floor of this one again the same number of inches higher than the third one, and so on. The advantage of this arrangement is obvious, for it enables the manufacturer to keep the fresher pickles separated from the older ones, since, when the time of harvesting arrives, he can discharge the pickle from the lowest section and draw onto the salt the pickle from the section above less charged with the deliquescent chlorides, for the purpose of removing as far as possible from the salt with this newer pickle the adhering chlorides and fine, needle-like gypsum crystals.

The depth of the rooms varies from 6 inches for lime and salt rooms to 12 and 14 inches for deep rooms. The movable covers are in 16-foot sections, capable of protecting a space of 16 by 18 feet square, or 288 square feet. The size of the yard is estimated by the number of covers it has. During fair weather the covers are pushed aside upon wooden frames constructed for that purpose beside the rooms.

Solar Salt "Aprons."

Within the last fifteen years, the Onondaga solar salt manufacturers have adopted a plan by which some of them have increased their evaporating surface to a considerable extent. They have added to their works, according to the space at their disposal, very large shallow vats from 20 to 100 feet wide by 200 to 2,000 feet long and about 3 inches deep. Wherever practicable they are erected over the deep rooms (serving instead of roofs), thus making the latter practically store rooms. These vats or aprons, as they are called, are built in a similar manner to the vats previously described, on piles or posts. At certain distances from each other are two sets of holes provided with wooden plugs. The surface of these flat vats is so constructed that any brine or rain water on them will run rather slowly toward these holes. One set of holes communicates with the deep room. During fair weather a small quantity of brine is allowed to run into these vats, not exceeding one-half inch in height. This often becomes entirely saturated in one day, when it is discharged into the deep room below, and its place is taken by a fresh portion of brine to be evaporated. In case rain is expected, the plugs over the deep rooms or cisterns are drawn, the brine runs off, the plugs are again inserted and those drawn out of the other holes, through which the rain water runs off.

The advantages of this method are; first, a much more rapid evaporation due to the shallow layer of brine, and secondly, the gain of all the lime rooms for salt rooms. Ordinarily a solar salt yard with 2,700 "covers" 10 by 18 feet square, consists of 1,800 salt rooms, 800 lime rooms, and 100 deep rooms. By this improvement the salt rooms are increased to 2,600. Moreover the iron (ferrous carbonate) and the sulphate of lime (calcium sulphate) separate very quickly. When rain prevents the lime from becoming saturated, before it is discharged into the deep rooms or cisterns, it is returned to these aprons by a pump. The increase in the yield of salt per cover by this method over the old one is about 15 to 20 bushels per season according to the size of the aprons belonging to a yard.

The amount of salt produced in a solar field during a season depends not only on the state of the weather but also on the composition of the pickle from which the salt is deposited, since if the latter is too highly charged with calcium and magnesium chlorides, due to keeping the old pickle over from season to season, evaporation may be greatly retarded thereby; in fact it may cease almost entirely, since whatever evaporation of water may take place in clear warm weather from a pickle overcharged with these chlorides, will be reabsorbed again by them during the prevalence of a damp, moist atmosphere. The quality of the salt depends on the weather to a certain extent, but mainly on the intelligence and care of the workman. Supplying the salt rooms with perfectly saturated pickle, allowing the harvested salt (after properly washing it with newer pickle from the section above to remove adhering gypsum crystals and chlorides) to drain properly both in the tub and the storehouse and finally to discharge the old pickle at the proper time, are of the utmost importance in the manufacture of a good commercial solar salt.

According to the laws of the State, the freshly harvested salt must remain 14 days in the storehouse before it can be put on the market.

2. Direct Fire Evaporation by the Pan Process.

Usually several pans are placed under one roof. They are constructed of large wrought-iron plates riveted together. The thickness of the plates is from ¼ to ⅜ inch. The usual dimensions are: width 20 to 24 feet, length 100 feet in two sections, and depth 12 inches. The front section is 70 feet and the back one 30 feet long, separated by a loose-fitting, wooden or iron partition, to allow the brine from the back section gradually to enter the front one. Adjoining the front pan is a back pan 30 feet long by 20 to 24 feet wide and 12 inches deep. The walls under this pan are from 12 to 16 inches higher to enable the easy transfer of the brine by siphon from the back to the front pan. The ends of these pans are at right angles to the bottom while the sides are oblique. The front pan is usually supported by two central and two outside walls (though there are some pans differently supported and constructed) which are 3 feet wide at their base and grates, tapering to one foot in width under the pan bottom. The distance from the top of the grate to the bottom of the pan is between 6 to [illegible] feet. The grates are 3 to 4 feet wide by 5 to 6 feet long. The walls are built in the most substantial manner and lined on the inside with firebrick in the front portion and with ordinary bricks farther back where the heat is less intense. To protect the pan bottom against a too intense heat directly over the fires, a firebrick arch is built, the crown of which is between 2 and 3 feet below the pan bottom. The arch is solid from the front wall to about 2 feet beyond the grates, where an open space of 6 to 8 inches wide is followed by a second arch from 12 to 16 inches wide, and this again, after an interval, by a third arch only a foot wide, and so on. These arches are called rings and their width decreases from the front of the pan toward the end while the air spaces increase in width in the same direction. Beyond 20 feet from the front of the first section of the pan they cease altogether. To convey the heat as close to the pan bottom as possible, beyond the last arch, the flues are usually filled in with earth or plaster, and thus the distance between the pan and flue bottom is between 3 and 4 feet, or even less, at the end of the first pan, where a perpendicular wall, a so-called bridge wall, reduces the space to about 1½ to 2 feet, through which the products of combustion pass under the back pan and finally into a common chimney.

For the purpose of draining the salt, before it is conveyed to the storehouse, an inclined wooden platform, the so-called "drip," is constructed along the entire length of both pans on either side, resting on the inclined iron sides of the pan.

The so-called settling of the brine is the same as in the kettle method, with this difference, that the settled brine, in consequence of the greater number of cisterns and their greater capacity, remains for 4 to 5 days undisturbed. If it is the intention of the manufacturer to make the so-called "factory filled salt" used for the dairy and the table, the settling with caustic lime is followed by a second settling with a certain quantity of carbonate of soda, or soda ash, as it is usually called by the workmen. The sodium carbonate is dissolved in salt water and the solution mixed with the brine. The carbonic acid unites with any caustic lime in solution in the brine, while the resultant caustic soda, together with the greater quantity of undecomposed sodium carbonate, decomposes the calcium and magnesium chlorides, forming calcium and magnesium carbonates and common salt. Between the settlings with lime and sodium carbonate 12 hours are usually allowed to intervene.

After the pans are properly cleansed they are whitewashed with a thin milk of lime to prevent their rusting until they become thoroughly heated; the fires are started and the pans are filled by siphons to a depth of about 6 inches with brine from the back pans. The former are so inserted that a constant flow of brine passes from the back pans into the last section of the front pans and from these under the partition into the first section. Into the back pan flows a constant stream from the outside cistern until the front pans are sufficiently full, when the flow is stopped. After a sufficient amount of salt has collected in the first section of the front pan, it is removed to the "drip" for drainage. This is called drawing or raking the pans. The front pans are refilled from the back pan, in which the brine has become considerably heated, and thus is prevented a too rapid cooling of the brine in the front pan, which would seriously interfere with the formation of a properly grained salt. For the same reason the partition is placed in the front pan since it prevents any cold brine from coming suddenly into the first section, it being compelled to enter at the bottom of the pan where its temperature is the highest. The first drawing or "drip" usually contains traces of caustic lime in consequence of the white-washing of the pans and since this would be detrimental to butter, cheese, provisions, etc., salted with it, it is always kept separate and sent into the market as "agricultural" salt.

The great advantage of the pan process over any other is mainly in the controlling of the grain. According to the object of the manufacturer, the salt can be made of any desired grain in a pan. When a fine-grained salt is desired, the fires are increased so that the brine in the first section boils over its entire surface. To aid in the formation of a fine-grained salt (very desirable for dairy and table use) some artificial means are employed. Butter, specially prepared soft soap (of course made of the best lard or tallow and alkali) gelatine, and white glue are some of the substances added, and the quantities used are so insignificant in proportion to the amount of salt that they could not be detected even if they remained, but the hard soap, the lime soap, floats on the brine and is very carefully skimmed off. When this kind of salt is made the pans are "drawn" every 45 or 60 minutes. In the manufacture of coarser-grained salt the "drawing" of the pans takes place at intervals of 2, 3, 4, 5, 6, or 12 hours, according to the size of the grain, and the temperature of the brine is reduced from 229 deg. F. to 200 deg. or even 148 deg. F. The storage room for the salt is usually in a separate building.

The amount of salt and its quality depends on the same conditions given under the kettle method. With good average coal dust and fair weather 80 to 90 bushels of salt per ton can be made in a well constructed pan during the summer season from saturated brine, which quantity will be reduced to 60

* Bulletin of the New York State Museum, Vol. iii., No. 11.

bushels during the winter months. A good average proportion for the entire year is about 1 ton to 72 bushels per ton with brine "up to saturation." The pan salt is always lighter than the kettle salt, bulk for bulk, since a pan never boils as rapidly as a kettle. Consequently the calcium sulphate in the former is very rarely deprived of its water of crystallization, and therefore the pan salt will usually dissolve perfectly clear in water.

(To be continued.)

[Concluded from Supplement No. 1447, page 23188.]

THE NORTH SEA FISHERIES.

By William P. Smythe, Consul at Hull, England.

THE APPRENTICESHIP SYSTEM.

Another blot on the fishing industry, although mostly confined to one particular area, is the apprenticeship system. Years ago, the London workhouses adopted the idea, from the best of motives, of apprenticing lads to the Grimsby smack owners, the advantage being that, at the expiration of the indentures, they had learned a trade. On the other hand, the owners appear to have welcomed the system upon the ground that it provided them with a supply of labor for elementary work on board. Actually, the trade of a fisherman under modern conditions is acquired so easily that the apprenticeship system is superfluous, and the result is that, as soon as the lads recognize their value, they desert the vessel in order either to secure an engagement on another trawler or to reach another port. In other instances, the rough life at sea—for which many of them are physically unfitted—or, occasionally, harsh treatment from the crew, leads to the same results. In such cases, the absconding apprentices are liable to prosecution, and one of the most painful features of the Grimsby trade is the frequency with which lads are sent to prison for one or two months, thus stamping them as felons at the outset of life. The British press has frequently severely condemned this system, and there can be no doubt that public opinion, even in Grimsby, perceives that the facile manufacture of young criminals is entirely out of harmony with current ideas. From the fact that in Hull the apprenticeship system no longer exists, and that out of 111 apprentices at the English ports 79 are to be found at Grimsby, it may be gathered that the method is in no way necessary to the industry, and as a matter of fact the system is steadily dying out, year by year.

THE HUMBER FISHERIES COMPARED WITH CONTINENTAL FISHERIES.

In order to illustrate further the extraordinary development during recent years at Hull and Grimsby as compared not merely with other English ports, but with the chief continental countries, the following table is presented:

Year.	Steam fishing boats.	
	Hull.	Grimsby.
	Number.	Number.
1891	135	98
1894	192	167
1899	260	280
1900	385	484

Yet, according to an official Belgian return, there were in February, 1901, only 26 steam trawlers under the Belgian flag, all sailing from Ostend; Denmark had only 2 in 1896 and 3 in 1899; France had in 1900 only 3 steam vessels engaged in North Sea trawling. The Netherlands had 2 in 1898, but the number has never augmented largely. Germany alone appears to have developed its steam fishing fleet to any noteworthy extent, the total having grown from 1 in 1886, 18 in 1890, 103 in 1897, to 126 in 1899. Thus, the striking fact is brought out that all of the other countries bordering on the North Sea own less than one-fourth of the number of fishing vessels sailing from the Humber ports alone, leaving out of consideration the numerous other east coast English fishing ports.

How unquestioned is the supremacy of the Humber ports in the English fishing industry is also illustrated by the following table, extracted from the official report for 1900:

WET FISH LANDED.

Port.	Quantity.	Percentage.
	Cwts.	
At Grimsby and Hull	3,439,271	40
At 11 other ports with over 100,000 cwts. each	4,157,064	48 3
At 25 other ports with between 10,000 and 100,000 cwts. each	745,076	8.7
At 72 other places	258,650	3
Total	8,600,061	....

THE PRICE OF FISH.

With respect to prices, it would appear that no exact relationship exists between the quantities landed in a given year and the average prices realized. Moreover, the popular demand for fish increases so steadily that, despite the immense increase in the quantities landed, market prices are well maintained, as the following table shows:

Year.	Average price per cwt.		
	Cod.	Haddock.	Ling.
[illegible]	\$3.35	\$2.33	\$3.46
[illegible]	3.34	2.47	3.32
[illegible]	3.02	2.37	3.83
[illegible]	3.56	3.32	3.12

Another feature of the British fish markets during the past twenty years has been the augmentation in price of the better qualities of fish, especially flatfish, and this although—despite a popular belief that these kinds of fish are being exhausted owing to lower rate of reproduction compared with commoner fish—the quantities brought to land have steadily increased. The appended table is instructive, as showing the extra price which must be paid at the luncheon or dinner table for superior fish as compared with a few years ago:

Year.	Average price per cwt.			
	Sole.	Turbot.	Plaice.	Halibut.
1890	\$30.89	\$17.75	\$4.62	\$7.29
1895	32.59	18.72	5.10	8.51
1900	36.73	20.20	5.83	8.26

Lobsters show a serious falling off in the numbers caught during the past decade; crabs, a slight decline; while oysters remain stationary. On the other hand, the price of oysters has substantially increased, while that of lobsters and crabs has not been materially affected.

THE FISHERMEN OF ICELAND.

A cleverly written article by Mr. A. E. Johnson in the Field Naturalist's Quarterly, which has been already cited, contains an interesting paragraph in reference to the fishermen of Iceland. This writer made a voyage in a Grimsby steam trawler to the Icelandic fishing grounds, and notes in a simple and graphic narrative the results of his observation and experience. He sees with keen discernment and good judgment the scenes presented to his view in those regions, and draws the following picture of the Icelandic fishermen as they appeared to him on the exposed coast of their native land:

"Frequent visits were paid to us, while in Faxe Bay, by crews of coast Icelanders. Hardy sons of the old Viking are these shore dwellers, with their high cheek bones, fair hair, and keen blue eyes, buffeting the waves and enduring the bitter cold often enough for twenty-four hours and more at a stretch in their small open boats. To them the development of the Iceland fisheries has meant much. Formerly, they wrested a bare living from the sea by fishing with lines for cod (as they still do when few trawlers are in the bay) and curing the hardly won catch on the beach for sale to the storekeeper in the town, who, after getting the best of a hard bargain, exported the fish to Spain and other fish-eating countries. But since the advent of the steam trawlers, the coast Icelander pursues a different course. Now, he makes a tour of the different ships, and barters whisky or cigars, or even home manufactures, such as slippers of seal or sheep skin, for a load of small or useless fish, rejected by the skipper, but which he carries back to the curing grounds and turns to profitable account. English shipowners hear of this traffic with disapproval, fearing lest valuable fish be thus lost to them; but in most cases the alarm is unnecessary, while the fishing grounds benefit by the removal of waste that would otherwise be flung overboard to rot on the bottom."

SCIENTIFIC INVESTIGATION OF FISHERIES WORK.

Much valuable work of a scientific nature is being carried on in order to ascertain the facts relating to the navigation and growth of sea fisheries. As the result of the recent international conference at Christiania, the British government guaranteed £3,500 (\$17,032) a year for three years to prosecute researches of this nature, and private liberality has augmented these resources by providing a steam trawler named the "Huxley," after the great biologist, in order to carry on the work under favorable conditions. Describing the mode of research, the Yorkshire Post says:

"The headquarters of the 'Huxley' will be at Lowestoft, and her research work will be in charge of Mr. W. Garstang, of the Marine Biological Laboratory, who will have a staff of four naturalist assistants and a crew of twelve. The first efforts of Mr. Garstang and his assistants will be to gain information on the migration of fishes and their rate of growth. Fish will be caught in the trail net with which the 'Huxley' is provided, carefully measured, and put back into the sea, with an identifying tablet of bone attached to the fleshy part of the dorsal fin by means of a piece of silver wire. The North Sea fishermen have been apprised of the nature of the experiments, and when they catch one of these marked fish they will receive a reward of 2s. (48.6 cents) on taking it to the Marine Biological Laboratory at Lowestoft. If the fish is valuable—for instance, a large turbot—compensation to the amount of the value of the fish, plus the reward of 2s., will be given to the fisherman. A register will be kept on board the 'Huxley' showing the exact measurement of the fish, the place where it was returned to the water, and the date. In this way, it is hoped to gain much valuable information concerning the rate of growth and migration of the *Pleuronectidæ*, the family of the side-swimming flatfish. The vessel will be at sea from a week to a fortnight at a time, scouring the North Sea for the purpose of making investigations in its once rich fishing grounds."

This, however, does not comprise all the work the English branch of the International Biological Research Committee has set itself to accomplish. Similar work will be done in northern waters by the Scottish Fishery Board, and in the English Channel a quarterly series of observations will be undertaken on such matters as the temperature and salinity of the sea and the floating life on the water. The herring and the mackerel subsist on these minute organisms on the surface of the water. These investigations will be conducted from the Marine Biological Laboratory at Plymouth.

IS THE SEA BECOMING EXHAUSTED?

From the earliest times of which we have records, the improvement of the facilities for catching fish has given rise to fears of the ultimate exhaustion of the resources of the sea. As far back as 1376, Parliament was petitioned to prohibit the use of an instrument called the "wondrychoune," by which "so many small fishes were taken that the fishermen did not know what to do with them but to feed and fatten their pigs, to the great damage of the whole commons of this Kingdom." Again, at various times, measures were passed regulating the size of nets, clearly showing that, in the eyes of the legislature, the destruction of immature fish was a peril to the food supply of the country. During the last century the cry was raised at intervals that the North Sea was becoming depleted of fish, and, whenever the agitation became politically significant, a royal commission was appointed to investigate the subject. Of these inquiries, the most important was that carried out in 1883 by a small number of experts presided over by the late Earl of Dalhousie, who visited the principal ports and collected a volume of evidence from the fishermen. The result was that the commission presented a report to Parliament setting forth that the alleged diminution in the fish supply had not been proved; but the agitation continued, and, as a concession to the line fishermen, sea-fisheries committees were constituted, which were authorized, if they saw fit, to prohibit trawling within inshore waters—that is to say, within 3 miles from land. The law is enforced most rigorously in Scotland, where the line-fishing industry is very strong; but so far from satisfying the malcontents, the demand is now being raised for an extension of the limit to 12 miles. In constituencies where the fishing element is powerful, no candidate is considered acceptable who is unable to pledge himself to vote for this change.

Scientific testimony, however, is almost unanimously opposed to further restrictions upon the fishing industry, and in no part of the country is this attitude more marked than in Scotland. Under the auspices of the Scottish Fishery Board, exhaustive tests have been applied during a series of years with a view to ascertaining whether the closing of the inshore waters against trawling operations has resulted in increased quantities of fish being found there. Prof. M'Intosh, of the University of St. Andrews, has tabulated the catches made during this extensive period by a vessel properly fitted out for the purpose, and has published them in a volume entitled "The Resources of the Sea." Briefly, Dr. M'Intosh, who approached the subject with a perfectly open mind, has convinced himself that the whole agitation rests upon a radical fallacy—that is to say, the fears of an ultimate extinction, or even a perceptible diminution, of the fish supply are entirely baseless. "The cry concerning the annual diminution of our fish supply has," he says, "been dispelled by the institution of statistics." The alleged destruction of spawn has no basis in fact; the destruction of immature fishes is common to all classes of fishermen, and nowhere has proved to have resulted in the ruin of any sea fishery. The closure of the 3-mile limit has failed to increase the number or size of the food fishes. The evidence given before the trawling commission of "trawling out" certain grounds in three years with a small vessel carrying a small trawl is at variance with experience. The statistics referred to by Prof. M'Intosh show that the quantity of fish landed in the United Kingdom (exclusive of shellfish) has risen from 12,800,000 cwts., valued at £6,000,000 (\$29,200,000), in 1889, to 15,500,000 cwts., valued at £8,400,000 (\$40,880,000), in 1898, and later reports prove that the increased catches are still in evidence.

Moreover, a greater authority, the late Prof. Huxley, has shown, in a manner calculated to appeal to the lay imagination, how idle are these attempts to check the operations of man in face of the colossal reproductive and destructive work of nature herself. In an address delivered some years ago to the national fisheries conference, he said:

"At the great cod fishery of the Lofoden Islands, the fish approached the shore in the form of what the natives call 'cod mountains'—vast shoals of densely packed fish 120 to 180 feet in vertical thickness. The cod are so close together that Prof. Sars tells us that the fishermen who use lines can notice how the weight, before it reaches the bottom, is constantly knocking against the fish. And these shoals keep coming in one after another for two months, all along the coast. A shoal of codfish of this kind, a square mile in superficial extent, must contain at the very least 120,000,000 fish. This allows over 4 feet in length for each fish, and a yard between it and those above, below, and at the sides. But it is an exceptionally good season if the Lofoden fishermen take 30,000,000 cod, and not more than 70,000,000 or 80,000,000 are taken by all the Norwegian fisheries put together. So that one fair shoal of all that approach the coast in the season must be enough to supply the whole of the codfish taken by the Norwegian fisheries and leave a balance of 40,000,000 or 50,000,000.

"The principal food of the adult cod appears to be herring. If we allow only one herring to each codfish per diem, the cod in a square mile of shoal will consume 840,000,000 herring in a week; but all the Norwegian fisheries put together do not catch more than half that number of herring. Facts of this kind seem to me to justify the belief that the take of all the cod and herring fisheries put together does not amount to 5 per cent of the total number of fish. But the mortality from other sources is enormous. From the time the fish are hatched, they are attacked by other marine animals. The great shoals are attended by hosts of dogfish, pollock, cetaceans, and birds, which prey upon them day and night and cause a destruction infinitely greater than that which can be effected by the imperfect and intermittent operations of man. I believe, then, that the cod fishery, the herring fishery, the pilchard fishery, the mackerel fishery, and probably all the great sea fisheries are inexhaustible—that is to say, that nothing we do seriously affects the number of fish, and any attempt to regulate these fisheries seems consequently, from the nature of the case, to be useless."

Dr. Brown Goode, of the United States fisheries department, stated upon the same occasion that American observation led to the conclusion that "the number of any one kind of oceanic fish killed by man is perfectly insignificant when compared with the destruction effected by their natural enemies." Mr. Shaw Lefevre, a member of the royal commission, gave his opinion thus:

"I think that it may be taken as an established and incontrovertible fact that there has been no falling off in our fisheries, but a very great increase; an in-

crease in most cases greater in proportion than in the number of men and boats employed, and giving an adequate return to the very largely increased capital devoted to them."

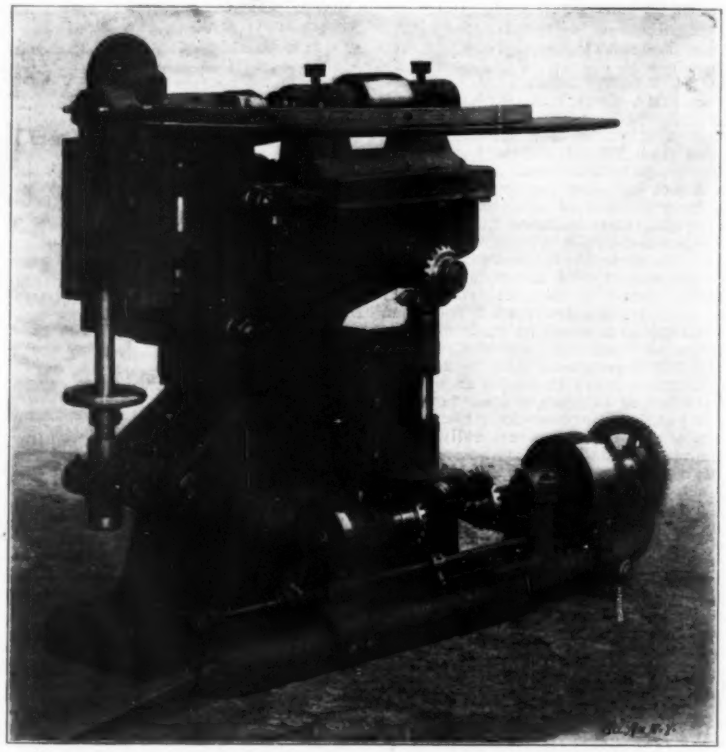
Lastly, as Prof. M'Intosh points out, the returns from the various centers all over the country have, for the most part, steadily increased since 1884, in which year the steam trawl may be said to have come into general use; and though it is true that large quantities are captured on the Great Fisher Bank, Iceland, and other regions at a distance from British waters proper, yet this is due to the more remunerative nature of the work and not to the dearth of fishes in the seas at home. The increase has not been fostered by the closure, but in the case of both liner and trawler, is due to enterprise which was independent.

IMPROVED MACHINERY FOR WHEEL MAKING.

MACHINERY has taken the place of manual labor in so many branches that it is difficult for the public to keep pace with all the latest advances. It is noticeable at the present time that these improvements relate particularly to skilled labor. Work which yesterday could be done only by high-priced mechanics, and was considered too complicated to be accomplished by any mechanical means, is now much more rapidly and perfectly done by a simple machine run by a cheap operator. Such machines obviously affect the work of but a few men, and consequently are not prominently brought before the public. We illustrate herewith a machine of this character, which is especially adapted to do the work of placing rim sections on wheels, and it has proved to be one of the greatest labor-saving devices that has so far been invented for wheel making. Before the introduction of this machine, this work had to be done by hand; the rim sections were driven into place by a hammer, which operation required a great deal of skill, and at best was slow and costly. The pounding had to be very evenly done, otherwise splitting or checking of the rim would result. The new machine does all this work much more rapidly and so evenly as to absolutely obviate the danger of splitting the rim.

The construction of the machine is quite simple. The wheel hub with its spokes is held in a chuck, supported upon ball bearings, so that it turns with greatest ease. The rim sections are supported on a table, and are so placed as to bring the spoke holes bored in them into alignment with the tenons of the spokes. Four plungers radially disposed at one side of the wheel chuck are mounted on reciprocating slides, and act as hammers to drive the rim onto the spokes. The plungers occupy different relative positions on the slides, the first plunger serving merely to start the rim onto the tenon and the others driving it a little further, until finally the fourth plunger drives it home against the shoulder of the tenon. The plungers can be adjusted to different positions to allow for wheels of different sizes, and the wheel clutch is capable of vertical adjustment to center the wheel with the plunger. The plunger slides are operated by eccentrics, which rotate between parallel ribs projecting from the lower faces of the slides. A cut-off saw is secured to a slide under the table above referred to, and may be instantly raised into operative position by depressing a convenient treadle. This saw is used to cut off any overlapping portions of the rims at the joints. Horizontal adjustment of the saw is provided, so as to allow for wheels of different sizes. The machine runs very quietly and smoothly, and requires no attention after the rim has been started on a tenon, except to turn the wheel. The plungers act simultaneously, which is a decided improvement on the hand method, for the pressure exerted is much more uniform, and the liability of injuring the wheel is thus overcome.

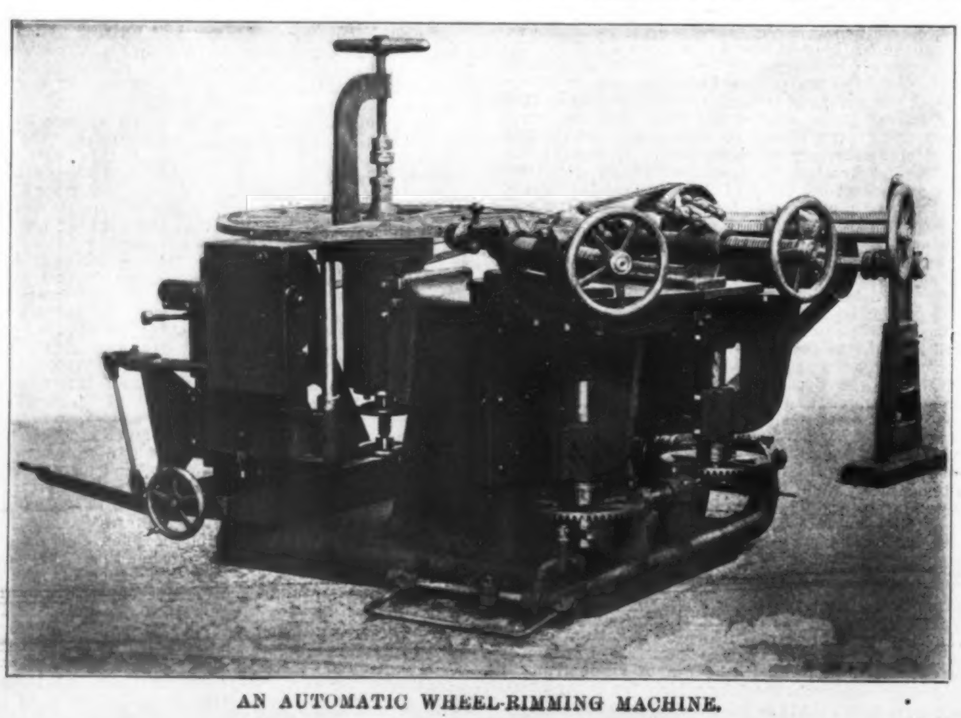
The process of preparing the rims for the rimming machine is interesting. This work is now also done by machinery. One of the accompanying engravings illustrates a machine adapted to do this work. The rim section is supported on a circular table, which may be quickly adjusted to suit any size of wheel, and the sections may be reversed to bore from either the inside or the outside of the work. The boring spindle is of steel and is fitted into heavy bearings; it is brought into action by a slight touch of the operator's foot on a pedal at the base of the machine. It does its work quickly, and returns automatically ready for the next touch of the operator's foot. The feed is regular so that the boring is smooth and there is no danger of injuring the tool. A peculiar feature of the machine is that it bores an oblong hole, which prevents the rim



MACHINE FOR BORING AND COMPRESSING FELLOES.

from splitting when hammered on the spokes, and obviates the necessity of using screws on each side of the felloe to prevent checking. A powerful compress pinches the rim at the point where it is being bored. This compress may be quickly adjusted to rims of different thicknesses, and it is arranged to act automatically, together with the boring spindle, without attention on the part of the operator. A self-spacing attachment is provided, whereby the distance between the spoke holes is accurately spaced out, thus saving time of laying out and marking the work, as by the old process. Improved cutter heads are furnished with the boring bits to face off a circular spot around the tenon hole on the inside of the rim, while the boring is performed, so as to secure a true surface for the shoulder of the tenon against the rim.

These machines were invented by Mr. George A. Ensign, of the Defiance Machine Works, Defiance, Ohio.



AN AUTOMATIC WHEEL-RIMMING MACHINE.

THE FUELS COMPETITION OF THE AUTOMOBILE CLUB OF FRANCE.

THE long-heralded Concours des Carburants of the Automobile Club of France has finally taken place and has been attended by a good measure of success. The experiments were conducted at the laboratory of the club, 128 Rue du Bois, Levallois-Perret, a suburb of Paris. All of the fuels entered for competition were tested with the same motor, a single cylinder, horizontal Gillet-Forest of 140 millimeters bore and 160 millimeters stroke (5.6 x 6.4 inches). This motor drove a dynamo the output of which could be read in volts and amperes by means of electrical instruments. Tests were first made with what is referred to as the standard gasoline of the laboratory, and the results obtained with this fuel served for purposes of comparison. The tests were conducted by M. Lumet, engineer in charge of the club's laboratory.

The experiments cover a large range of fuels, including some which are not ordinarily used in automobiles. No difficulty was experienced with the heavier grades of gasoline, and this led M. Forestier, who was superintending the trials carried out by the laboratory engineer, to send for some ordinary kerosene of 0.795 specific gravity, which he had tested with the standard gasoline and 90 per cent alcohol, with the following result: Running at 650 revolutions, the gasoline furnished 3,965 watts, with a consumption of 1.19 gallons per horse power per hour; at 800 revolutions the pure alcohol gave 3,640 watts with a consumption of 1.25 gallons, and at 900 revolutions the kerosene furnished as much as 5,940 watts with a consumption of only 1.146 gallons. The kerosene was used with a Longuemare carbureter under the same conditions as the gasoline. The results obtained are so remarkable that it is intended to carry out further trials with kerosene, and M. Deutsch, the French petroleum refiner, has sent several samples for testing purposes.

In the table herewith the different fuels are divided into groups according to specific gravity. The consumption is given in United States gallons. The average consumption per brake horse power, with the gasoline under 0.700 specific gravity (71 deg. Baumé), was 0.123 gallon per horse power hour; with gasoline between 0.700 and 0.715 specific gravity (71 deg. and 66.5 deg. Baumé), 0.1145 gallon per horse power hour;

RESULTS OF FUEL COMPETITION.

Trade Name of Fuel.	Specific Gravity	Temperature (centigrade)	Revolutions per min.	Horse power	Fuel consumpt'n per hour (gals.)	Fuel consumed per b. p. hour
	Below .700					
Motoline—Lepretre	.695	23.5	800	10	1.29	.129
			650	9.75	1.16	.119
Essence A—Deutsch	.647	22	800	9.76	1.35	.140
			650	9.43	1.22	.129
Vaporine A—Lille et Bonnières	.686	21.5	800	10	1.19	.119
			650	9.53	1.13	.119
Vaporine B—Lille et Bonnières	.696	23	800	10	1.15	.115
			650	9.05	1.06	.117
	.700—.715					
Vaporine C—Lille et Bonnières	.714	21	800	10	1.15	.115
			650	9.21	1.05	.114
	Above .715					
Motoline No. 2—Lepretre	.718	21	800	9.63	1.37	.143
			650	9.48	1.25	.132
Motoline No. 3—Lepretre	.732	22	801	9.50	1.22	.129
			650	9.49	1.08	.115
Essence B—Deutsch.	.725	21	800	10	1.24	.124
			650	9.74	1.08	.111
La Rapide—Cocar	.717	22	800	10.13	1.20	.119
			650	9.86	1.09	.110
Eclair—Cocar	.726	22	800	9.14	1.10	.120
			650	9.08	1.00	.111
	Various Fuels					
Luciline	.798	23	900	7.42	1.08	.146
Carburine—Lepretre	.801	22.3	800	9.87	1.17	.119
			650	9.12	1.05	.115
Moto-petrole—Deutsch	.815	25	800	10.14	1.15	.114
			650	9.29	1.11	.119
Luminol petrole—Cocar	.820	22	800	10.31	1.39	.135
			650	10	1.28	.128
	Alcohol Mixtures					
Electr.—Lepretre, 50% alcohol	.842	24	800	9.25	1.36	.147
			650	9.02	1.24	.137
L'Etincelle-Cocar, 30% alcohol	.824	22	800	9.88	1.95	.198
			650	9.84	1.74	.177
Alcohol—Cocar, 5% alcohol	.849	23	800	10.26	1.46	.142
			650	9.57	1.35	.141
Alcohol "Volant"—Lille et Bonnières, 40% alcohol	.774	20	800	10	1.55	.155

with gasoline heavier than 66.5 deg. Baumé, 0.121 gallon per horse power hour; with various fuels of heavy grade, 0.125 gallon per horse power hour, and with alcohol mixtures, 0.157 gallon per horse power hour. The consumption with alcohol is thus about 28 per cent greater than with gasoline for the same power. The power is nearly the same for all fuels, except one. The column giving the horse power has been calculated from the two columns giving the total hourly consumption and the consumption per horse power hour respectively.—Horseless Age.

A NEW FORM OF FRICTION CLUTCH.*

Stated briefly, the four conditions which seem to be involved in the problem of the friction clutch are:

(1) It must have sufficient gripping power.

(2) Undue wearing of the surfaces must be avoided.

(3) Provision must be made for conveying away the heat where there is much slipping contact in the clutch.

(4) Motion should be imparted to the driven shaft without shock.

We are thus met at the outset with the contradictory conditions which have made the problem of the friction clutch such a difficult one. The author does not remember seeing in any previous writings on the subject, or in the statements of inventors themselves, the important fact mentioned in condition (3), but it certainly does account for the large number of instances in which friction clutches have failed to give satisfactory results for anything but the smallest powers.

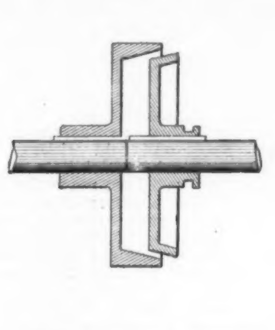


Fig. 1.—CONE CLUTCH, WEDGING ACTION.

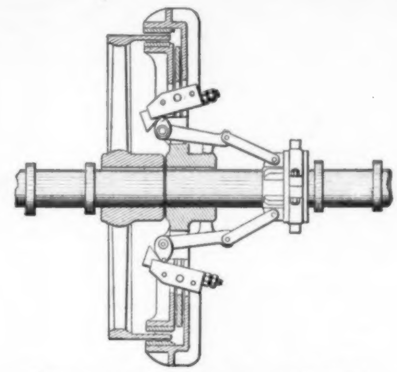


Fig. 2.—RIM CLUTCH, CLAMPING ACTION.

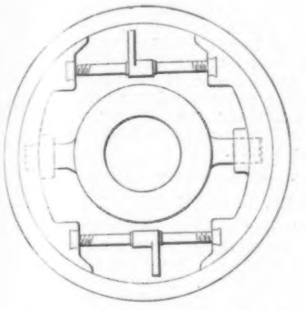


Fig. 3.—DRUM-EXPANDING CLUTCH.

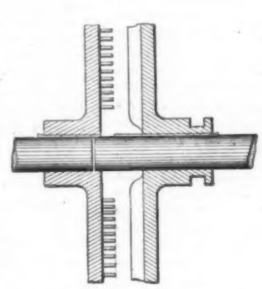


Fig. 4.—BRUSH CLUTCH.

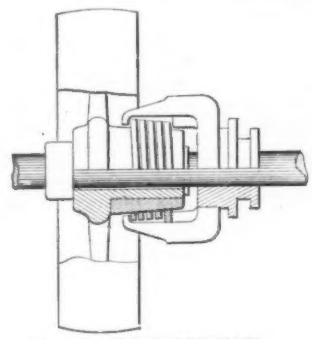


Fig. 5.—COIL CLUTCH, GRIPPING ACTION.

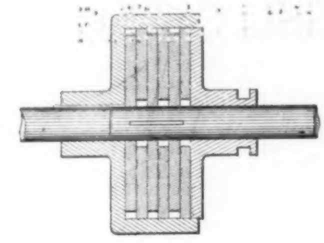


Fig. 6.—WESTON CLUTCH, INTERPOSED FRICTION PLATES.

Looking at the various clutches in use, they may be classified and represented diagrammatically as follows:

(1) The cone clutch (Fig. 1), where considerable pressure between the surfaces is obtained by the wedge action of the cone.

(2) Various forms of rim clutch (Fig. 2), in which the action is obtained by means of levers.

(3) Clutches with rings or segments expanding within a drum or annulus (Fig. 3).

Fig. 7.—PAIR OF CORRUGATED FRICTION PLATES, SHOWING CLEARANCE.

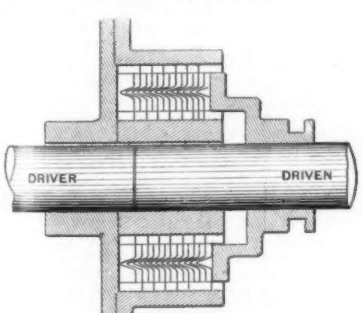


Fig. 8.—USUAL ARRANGEMENT OF CORRUGATED PLATES.

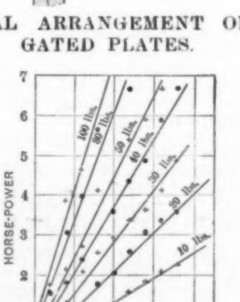


Fig. 9.—POWER TRANSMITTED AT VARIOUS PRESSURES.

(4) The brush clutch (Fig. 4) in which brushes of wire are thrust into a finely serrated or grooved plate.

(5) The coil clutch (Fig. 5), in which a coil of metal or wire rope with blocks is employed to give great gripping power.

(6) The Weston clutch (Fig. 6), in which the friction effect is produced by a number of circular disks connected alternately with the driving and driven machine.

There are numerous modifications in detail of all these clutches, but the inventions in connection with them—which are very numerous—relate principally to the mode of obtaining the requisite pressure between the friction surfaces. Thus taking the case of the expanding ring or segment, which is one of the most successful forms, wedges, right and left-handed screws, and toggle joints, have all been used in different ways for expanding the rings or segments; but no clutches appear to have been designed for the purpose of allowing slipping to take place to any considerable extent, so as to prevent, at the same time, undue wearing and heating of the friction surfaces. These clutches, if not transmitting considerable power and not required to slip, serve their purpose very well. Some, such as the coil clutch, the Weston clutch, and the expanding ring clutch, may be made to transmit great powers, but it may be safely said that not one of the foregoing clutches has yet been designed so as to be capable of slipping for more than a very short time, without being seriously injured, even if the surfaces in contact were not actually destroyed.

There are plenty of illustrations in mechanical science where it has hitherto been impossible to reconcile conflicting conditions, such for instance as the variable change-speed gear, and it is an important question whether the present case forms another example or not. The author believes there is a way out of the difficulty, and this he proposes to bring forward.

Suppose a sheet of metal is pressed into a frustum, the section of the corrugation being the frustum of a cone, and that the disk is placed upon another one similarly corrugated. It will be observed that not only do portions of the frusta not make contact with each other, but there is also a space left between the flat portions of the disks.

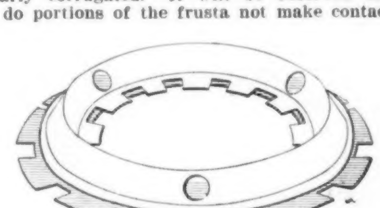


Fig. 10.—PLATE SHOWING HOLES FOR LUBRICANT.

By placing these disks together as in Fig. 7, and turning one alternately to the other, an amount of friction is produced which depends on the acuteness of the angle of the frusta. If a number of these plates are now placed in a box of the type of the Weston coupling, so that the plates alternately engage with two sleeves, one connected with the driver and the other with the follower, as in Fig. 8, it will be found: first, there is very considerable gripping power; second, there is a tendency to part rapidly with heat, owing to the separation of the disks of metal.

The gripping power will be found much greater in

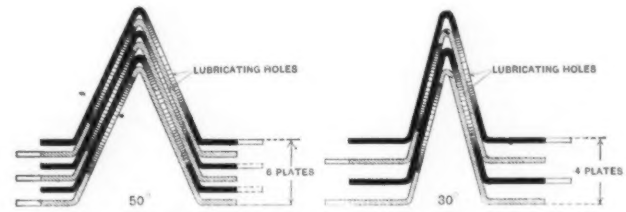


Fig. 11.—CIRCULATION OF LIQUID AT DIFFERENT PLATE ANGLES.

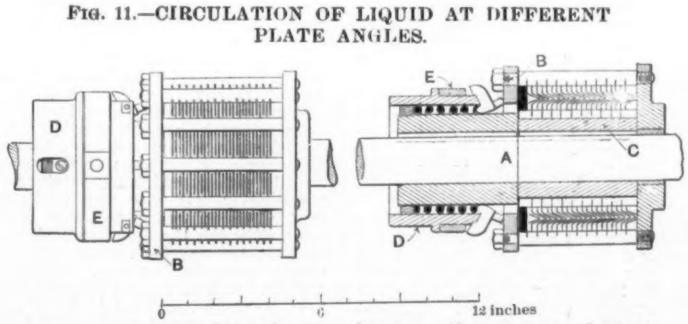


Fig. 12.—OPEN AIR-COOLED CLUTCH, WITH TRIGGERS.

* Condensed from a paper read by Prof. H. S. Hele-Shaw before the Institution of Mechanical Engineers, Leeds, England.

a box of given length than with the Weston clutch, and yet this cannot be accounted for by the ordinary laws of friction, since the increased effect of the wedge action (which varies with the cosecant of the angle of the cone) is directly in proportion to the diminution in the number of plates which it is possible to put in a box, which diminution varies according to the same law. There is, however, a still more striking difference between the gripping action of the flat and corrugated plates when a lubricant is introduced.

Some explanation is, therefore, needed of this effect, and the conclusion has been arrived at that this is due—in part at any rate—to the necessary deviation from the truly circular form of the corrugations in the plates.

Fig. 9 shows the results of a series of experiments with plates of 35 deg. angle, represented so as to give the horse power for any number of plates with varying pressures. Efficient lubrication of the surfaces in contact is insured by drilling the faces of the plates as shown in Fig. 10. This method is also indicated in the sectional view, Fig. 11. It will be noticed from this illustration that the number of plates in a given space depends upon the angle of the corrugation; thus, four plates with 30 deg. occupy the same space as six plates with 50 deg. These four plates, however, give a better grip than the six plates with 50 deg., and have the great advantage of allowing a freer circulation of liquid, as may easily be seen from the figure. The plates are also much more rigid with the more acute angle.

Two views of a standard type of clutch for shafts up to two inches diameter are shown in Fig. 12.

The shaft is divided at *A*, the outside case, *B*, being keyed to the left-hand piece of shafting, and driving the set of plates having external driving teeth. The core, *C*, keyed to the right-hand shaft drives the plates as follows: The sliding sleeve, *D*, containing a coil spring, is fitted with pins which project through the outside case of the clutch; these pins press against a flat disk, which in turn presses against the plates causing the clutch to drive.

When the operating lever is worked so as to release the plates, the ring, *E*, encircling the sleeve, withdraws the trigger pins from the holes into which they fit; the spring pressing on the opposite end of the trigger pin, causes the trigger to fly up, and the clutch is hereby kept out of operation.

By moving the lever so as to force the ring, *E*, against the trigger, the pin end falls into the hole opposite it, and the coil spring is then allowed to transmit its pressure to the plates.

The same clutch may be inclosed, with slight modifications, in a tight case and run in oil.

The writer has designed a reversing gear of this type for a steam turbine of 1,000 horse power, the number of revolutions per minute being 700 to 800. The action of this type of reversing gear may be made as quick or slow as desired, but with a fairly heavy flywheel attached to the gear, it has been found possible to change from full speed in one direction to full speed in the opposite direction in five seconds.

A satisfactory clutch is one of the most difficult things to secure for the motor car. The ordinary type of cone clutch, which is generally employed, the cone of which is covered with leather, can seldom be maintained in a normal condition for the following reasons: A great command over the car, especially in driving through traffic, is secured by allowing the clutch to slip. When slipping has been going on for some time the surfaces are generally so altered in their condition that either the clutch will not grip at all or it grips violently and harshly. The result in driving is not only most unpleasant, but it is very inimical to the car itself.

The author originally fitted one of his new clutches to a fairly heavy car, on which the engines had been changed from 6 to 12 horse power. This clutch, although the plates were only six inches in diameter, drove the car so satisfactorily that the 6 horse power gear has, under very trying conditions of the British Association tests on road resistance, been found quite strong enough for the purpose. Since then he has changed the cone clutch of a 24 horse power Darracq car for one of the type described in this paper with remarkable improvement in its action. It has been found capable of driving the car so altered, although a fairly heavy one, for long distances, even in hilly country and without ever going off top speed, which is a direct gear to the driving wheels. The actual speed at the normal revolutions of the engine on this car is seventy kilometers (i. e., about forty-five miles) per hour. This example shows the possibilities of the clutch, with which the car can be driven for any required distance at the speed of three or four miles per hour, or even less, and after running for an hour or two under these conditions the clutch does not get hot. Of course the main object of the change gear, which is to increase the power if necessary, is not attained, since the slipping of the clutch can only involve loss of power, but this is a case in which, with an engine of sufficient power, variation in the range of speed is really a more important object rather than the saving in power.—The Automobile.

THE SUMMER MEETING OF THE IRON AND STEEL INSTITUTE.

THE summer meeting of the Iron and Steel Institute began on the 2d instant at Barrow-in-Furness, the president, Mr. Andrew Carnegie, in the chair. In the address of welcome the Mayor referred to the rapid growth of Barrow. In 1837 the population numbered 100, in 1847 it had increased to 325, while at present there was a population of between sixty and seventy thousand, the majority being of the working classes dependent upon the iron and steel works and the shipbuilding and engineering industries.

Col. Vickers, who spoke in the absence of the chairman of the reception committee (the Duke of Devonshire), welcomed the members to the various works open for inspection.

The president, after returning thanks on behalf of the Institute, in the course of his address, said that it was twenty-nine years since the Iron and Steel Institute held a meeting at Barrow, and this carried the date back to the very beginning of Bessemer steel manufacture in America. It was at that meeting that Mr. A. L. Holley, who was then engineer to the Carnegie Steel Works, read two papers which first brought to the attention of British steel makers the doings of their brethren in America in developing the Bessemer process. Another paper read at the former Barrow meeting was by David Forbes, and was upon the progress of the iron and steel industries in foreign countries. From this it would appear that in 1873 the Pennsylvania Steel Company made 20,000 tons of steel rails. They now made that amount in two weeks. Continuing, Mr. Carnegie said that the work of a week was now done in a day, but, great as was that contrast, there was one still greater. There had been made and sold without loss hundreds of thousands of 4-inch steel billets at 3 pounds for 1d. Surely the limit had been reached there. He thought it had been, and he considered it doubtful whether there would ever be a lower price for steel. The vital element was the supply of iron ore, and the attention of iron and steel manufacturers should be directed to where and how they could obtain a supply. This was also a question which the manufacturers of America could not safely neglect, and it was for this reason that the United States Steel Corporation secured an abundant supply of the best ore obtainable. For 60 years the United States Steel Corporation could be supplied at its present rate of consumption, but that time was as nothing in the life of a nation. It was upon future discoveries of iron ore that the continuance of cheap steel manufacturing even in America would depend. There were immense deposits in now inaccessible parts. In Utah, for instance, and in Southern California large quantities had been found.

ALLOYS OF IRON AND TUNGSTEN.

The first paper taken at the meeting was a contribution by Mr. R. A. Hadfield, of Sheffield, the subject being "Alloys of Iron and Tungsten." The author pointed out that the strength or density of iron in its hitherto purest form produced commercially (about 99.9 per cent of iron) was 18½ to 20 tons per square inch. In cast iron the density might go as low as about 5 tons to the square inch, and in steel might rise to considerably over 100 tons, or, in the form of wire, to over 200 tons per square inch. The author had obtained by a nickel manganese addition to iron an alloy having the extraordinary elongation of 76 per cent on an 8-inch specimen. While iron was the most magnetic metal known, by the addition of manganese, a substance was produced practically inert to magnetization. As tungsten appears to raise the melting-point of iron, alloys containing more than 40 per cent of it are produced with difficulty. In 1892 the average price of tungsten ore was under £20 per ton. The sources of the ore were now more numerous, and prices were likely to fall rather than rise. Tungsten did not, the author said, oxidize in either dry or wet air, but was easily converted into a trioxide by heating to low redness in oxygen, air, or steam. Mushet did more than anyone else to effect the production of tungsten steel for tools, his product containing from 7 per cent to 12 per cent of tungsten and 1½ per cent to 2 per cent of carbon. For many years his methods were kept secret. In the physical data given in the paper it was stated that tungsten, like chromium, is, as far as was known, not malleable. The purest forms which the author had been able to obtain possessed hardness and brittleness, and were not ductile either in the ordinary or heated condition. The author concluded by saying that, though tungsten iron alloys would have an improved future, there was no doubt that, so far as could be seen at the present time, their use was not likely to be on the same large scale as some of the other special steel now produced.

A brief discussion followed, in the course of which Mr. Harboard referred to some unpublished results of experiments he had made with alloys of tungsten in Bessemer steel some time previously, the tungsten ranging from 0.1 up to 1.5 per cent. His results confirmed those of Mr. Hadfield in every respect.

DANGEROUSLY CRYSTALLINE STEEL.

The next paper was on "The Restoration of Dangerously Crystalline Steel by Heat Treatment," the authors being Messrs. J. E. Stead and A. W. Richards. The authors commenced by pointing out that it had been completely demonstrated that when steel of coarse structure, but not necessarily brittle, is heated to a certain temperature, 840 deg. C., and then is allowed to cool in the air, or is quenched in oil or water, the original structure is destroyed, and is replaced by one of a very fine character. The authors had for several years devoted much time and attention to the effect of heat on the mechanical properties of steel. They had repeatedly restored dangerously crystalline steel in large pieces by simple heat treatment, and obtained material which would be accepted by any engineer as excellent. They thought, therefore, an account of the work would not be without value. They had found dangerously crystalline steel to occur in three classes of the metal. The first class occurred only in mild steel very low in carbon, and in pure iron it was caused by annealing for a long period at too low a temperature in a slightly oxidizing atmosphere. The second class, which was equally dangerously crystalline, was very common; it was produced by long-continued heating at high temperature. The third variety occasionally met with was produced by heating the steel until it was practically burnt. In the third class, although the metal could be gradually improved by heat treatment, it could never be thoroughly restored simply in that way. In the case of steel of the first and second classes no such difficulty was found, heat treatment making it equal and more often superior to the forged steel which had been worked and finished at proper temperatures. The authors proceeded to give at considerable length details of experiments made on rails, and also gave particulars of some tests made with 5-inch steel blooms. The question of resistance to repeated alternations of stress was next dealt with, the manner in which tests were carried out being given. Practically, the results of the authors' investigations showed that, not only the original good qualities of normal rolled steel after being made brittle are restored by the exceedingly simple treatment of reheating to about 900 deg. C. for a very short time, but that such steel is made considerably better than it was. The authors also urged that in every large forge and smith shop a Le Chatelier pyrometer should be introduced, and in addition suitable furnaces for reheating the forgings should be established, and the authors feel confident that if the appliances to which reference has been made were to be intelligently employed, the finished forgings would be greatly improved.

Another interesting paper read at this meeting was that dealing in the probability of iron ore lying under the sands of the Duddon Estuary, by Mr. J. L. Shaw. Herr Heinrich Ehrhardt read a paper on the rolling of weldless steel pipes. A number of other papers of a rather technical nature were read during the meeting. Among these may be mentioned seven separate papers on steel and its peculiarities by Messrs. J. E. Stead, F.R.S., Arthur Richards, E. D. Campbell, Thomas Baker, M.Sc., William Campbell, Ph.D., U. S. Lloyd, and Alfred Stansfield, D.Sc. Mr. D. A. Louis Fie contributed a paper on coke oven practice, and Mr. Pettigrew a dissertation on coal as fuel at Barrow-in-Furness.

During the stay of the Institute at Barrow a visit was paid to the shipyard and engineering works of Messrs. Vickers, Sons & Maxim. These works, originally the property of the Barrow Shipbuilding Company, were purchased by the present owners in 1897. They cover an area of over 80 acres and employ over 10,000 men. In the engineering department, which, being under cover, was far pleasanter to visit during the incessant downpour, there was seen a collection of machine tools and mechanical appliances which has become famous all over the world. The battleship "Libertad" and his Majesty's ship "Dominion" were seen in course of construction. Another of the visits was to the works of the Barrow Hematite Steel Company and to the Hodbarrow mines. At the latter the sea wall which has been erected to facilitate the working of the ore deposits was inspected. It has been constructed to the designs of Messrs. Cooke, Sons & Matthews. On the same evening as this visit a conversazione was held in the Barrow Town Hall by invitation of the Mayor and was numerously attended.—The Shipping World.

FUTURE WATER SUPPLY OF NEW YORK CITY.

THE commission of experts which has been examining into the question of an increased water supply to meet the future needs of New York city has reported to the Board of Estimate. It is proposed to build a truly gigantic aqueduct at a cost of about $50,000,000, by means of which the city can obtain upward of 200,000,000 gallons of water per day within five years' time, and which when the proposed scheme shall have been fully developed, shall be capable of bringing 500,000,000 gallons per day into New York and delivering it to the city at an elevation of 300 feet above tide level by means of its own gravity, that is to say, without any pumping. This commission consisted of William H. Burr, of Columbia University, Rudolph Hering, an eminent hydraulic and sanitary engineer, and John R. Freeman, a hydraulic engineer of world-wide reputation. The conclusions reached by the commission are as follows:

THREE POSSIBLE SOURCES.

"(1) Notwithstanding the most favorable anticipations relative to the prevention of waste, the immediate beginning of the construction of a large additional supply is urgent.

"(2) We were advised at the outset by the corporation counsel that, owing to probability of litigation and consequent delay, we should not consider any streams flowing from New York into a neighboring State or waters outside this State. We find that it is possible to obtain an adequate additional supply of excellent water from streams lying wholly within the State of New York.

"(3) It is feasible to secure an additional supply, larger than the present Croton and Bronx supply plus the present Brooklyn supply, capable of gradual development up to five hundred million gallons per day, from the following sources:

"(a) From certain of the eastern tributaries of the Hudson, namely, the upper Fishkill, the upper Wappinger, and the upper Roeliff Jansen Kill.

"(b) From a portion of those just named in combination with the head waters of Esopus Creek, on the easterly side of the Catskill Mountains.

"(c) By pumping and filtering water taken from the Hudson River six miles or more above Poughkeepsie, or near Hyde Park; the flow in time of drouth to be reinforced from storage reservoirs to be constructed in the Adirondacks for the purpose of preventing the upflow of salt water to the intake.

"All other possible sources have been considered, but none possess the advantages of those named.

"Each of these sources involves some special difficulty, and each has some advantage in location, quality, or expense. Our preliminary estimates show no great difference in total cost.

THE UPLAND WATER PREFERABLE.

"We are unanimous in our preference for the upland water to that of the Hudson, although the Hudson can be made pure and palatable by filtration and should be regarded as in reserve for the more remote future.

"We recommend a gravity supply from the sparsely inhabited uplands [1] immediately north of the Croton watershed and [2] in the Catskills, but pending the completion of surveys and the comparison of detailed estimates we are not ready to state which of the storage reservoirs should be first built or which of the watersheds of the Fishkill, Wappinger, or Esopus Creek, or the Jansen Kill should be first developed.

"We have had surveys made both for a high-level aqueduct delivering water at nearly 300 feet above tide at the northern limit of the city, and for a low-level aqueduct delivering at the same elevation as the present Croton supply, in order to study their relative costs, and we are unanimously of the opinion that the first additional supply introduced should be delivered at the high-service elevation, which can be accomplished without pumping.

ADVANTAGES OF A GRAVITY SYSTEM.

"Manhattan has now two low-level aqueducts and two large low-level distributing reservoirs. The high-service demands are growing rapidly, and in some of the higher parts of the city a heavy burden of expense in the aggregate is thrown upon owners or occupants in the necessity for house pumps. Under a lax administration, the economy and repair of a pumping plant may suffer far greater impairment without attracting public notice than a gravity aqueduct system; and there are elements of safety in a high-pressure gravity supply for use in connection with special fire protection mains in some of the extra hazardous conflagration districts.

"(4) It appears possible to obtain from the upper waters of the Fishkill, Wappinger, Jansen Kill, and Esopus Creeks, by means of storage in the great reservoir sites now under survey, 500 million gallons daily, or as much thereof as needed, all of which will flow by gravity at such an elevation as to be delivered at the city limits at about 300 feet above tidewater, or nearly as high as the present high-tower service, without pumping.

"(5) By a judicious mingling of the hard water of some of the above gravity watersheds with the soft water from others, the combined supply from these elevated sources will be fully as soft as the present Croton supply. This matter, however, requires further study of the effect of spring floods upon the softness and turbidity of the stored water before exact figures can be given.

"(6) After a full consideration of economy and expediency, in view of the fact that any possible aqueduct line must be largely in tunnel and must be built of size suitable for future needs, delivering at times more rapidly than at the average rate, we recommend that the next aqueduct be built of a capacity of 500 million gallons per twenty-four hours.

CONSTRUCTION OF FILTERS RECOMMENDED.

"(7) We strongly recommend that the city should at once begin the construction of filters, both for the Croton water and for all other waters taken from surface streams and we have surveys and plans for filtration in progress for each and all of the new sources recommended. Further plans and estimates must be completed before we are ready to state our conclusion as to the most favorable sites for filtration plants.

"(8) We consider that the surface streams that form so large a part of Brooklyn's present supply should either be filtered, as already in progress, taking the most polluted first, or that the ground water, being naturally filtered, should be taken, so far as practicable, by means of carefully planned wells or intercepting galleries of a design yet to be perfected.

DAMS AND A TUNNEL NEEDED.

"(9) The one great natural obstacle which limits the date of the early introduction of an additional supply from any and every adequate source within the State of New York, is found in the long, deep tunnel under the mountains and hills east of Peekskill. There are also some high dams needed in some of the projects, and it now appears that under the most prompt action and with the best of management fully five years will be required after construction is begun before the water of any additional up-country supply can be delivered in New York.

"(10) For nearly its entire length the aqueduct has to be built of full size for its ultimate five hundred million gallons daily capacity, and although but two reservoirs be built at first, it is most expedient to construct them of full capacity and with their dams at full height. Therefore, the first installment of the completed work will be the most expensive, and after this from time to time, as the city grows and its population increases, other reservoirs can be added or extensions made to more distant points at comparatively small outlay.

"The preliminary estimates indicate that the expenditure for the first installment of the increased supply will be not far from fifty million dollars. This will complete the necessary dams, reservoirs, aqueducts, tunnels, and filters, and acquire the necessary lands and rights sufficient for a daily supply of upward of two hundred million gallons.

"This is a large sum, but for comparison we may note that the Boston metropolitan district has, within the past eight years, expended about twenty million dollars upon an additional supply of about one hundred and ten million gallons daily, for a total population now of about one million.

"The new Croton aqueduct, about thirty miles long, built mainly between 1886 and 1892, cost complete about twenty million dollars. The Jerome Park reservoir will cost probably eleven millions, and the new Croton dam and accessory works probably ten millions, which, exclusive of recent reservoirs in the Croton watershed and other appurtenant works, brings the total up to more than forty million dollars for the extension of the Croton system since 1885.

"The revenue of the water department for Greater New York collected in the current year will be upward of nine million dollars, and will normally show an increase of half a million dollars per year.

THE LONG ISLAND SOURCES OF SUPPLY.

"(11) Our Long Island investigations, so far as completed, indicate that the water resources of Long Island should be utilized to the greatest possible extent for the public supply of communities on Long Island, including Brooklyn, and that the use of this water in general will be cheaper than to bring the additional water wholly from the north; moreover, its entire independence is a safeguard against disaster, but the greatest amount of additional water that can be had here without extensions into Suffolk County may not be more than enough to take care of the natural growth of Brooklyn and the other Long Island communities until the water from the north becomes available, or until it becomes demonstrated to the public that ground waters from Suffolk County can be taken without real injury to local interests.

"(12) The need of a further water supply for Queens Borough is urgent, and we have recommended the development of the present ground water supply on lines already undertaken by the department as submitted to the Board of Estimate and Apportionment.

"(13) The Borough of Richmond has no adequate supply available within its own limits and its needs are also urgent. The increased supply for this borough may in time be taken from the water supply of Brooklyn when increased by the additional supply to be secured from the north. We approve of the measures now being taken to secure in the meantime the needed water from the nearest available supply on the mainland of New Jersey.

"(14) We find no possible quickly available and near source, or anything that would be worth the trouble or expense of development as an interim supply to make good the present excess of consumption in Manhattan and the Bronx over the recorded actual yield of the present watersheds in a year of extreme drought. We therefore urge water-waste prevention in strongest terms, as the best and cheapest safeguard; and, after having seen the result of the earnest efforts at waste prevention made in certain typical districts during the past season, by means of district meters and house-to-house inspection, urge the continuance and extension of this kind of work. The members of this Commission desire to record their unqualified recommendation of the immediate extension of metering to classes of buildings not yet included in the ordinances, as one of the best means of permanent prevention of waste."

The Commission, immediately after organization, divided its work into six departments, and for taking charge of the detailed studies sought engineers of extended experience on similar works. These departments were:

Eastern Aqueduct and Reservoir Department.
Catskill Department.
Filtration Department.
Chemical and Biological Department.
Long Island Department.
Department of Pumping.

WATER WASTE PREVENTION.

Studies of water waste had already been begun by Nicholas S. Hill, Jr., and I. M. de Varona, chief engineers in Manhattan and Brooklyn respectively. From the results, which have already been set forth in reports to the Board of Estimate, the experts drew the following conclusions:

(1) The leakage from the mains is much less than hitherto supposed. The distribution system of New York needs many new gate valves and hydrants to bring it into satisfactory condition, but the deterioration of the street mains is not such as to require extensive renewals to prevent waste.

(2) The main sources of waste are leaky fixtures and defective plumbing design. The loss from leaky fixtures probably exceeds 15 per cent of the total supply in the Manhattan and Bronx boroughs, or upward of 40,000,000 gallons per day. The reduction of waste due to leaky fixtures can be accomplished by constant inspection. . . . We do not believe it feasible to reduce materially the extravagant use of water due largely to defective plumbing design.

(3) The reduction of all waste is effectively aided by the use of meters, which should be extended to other classes of buildings than those now metered. We recommend that all buildings over five stories in height be metered at the earliest practicable date. . . .

(4) One important result demonstrated by these investigations is the absolute unfairness of frontage charges, leading to marked inequality of burden on users in different portions of the city. This is most manifest in connection with the large apartment-houses covered by our recommendation to extend meters to all buildings over five stories in height. . . .

WHERE RESERVOIRS HAVE BEEN PROJECTED.

The Aqueduct and Reservoir Department, east of the Hudson River, began operations on February 4. These operations have thus far included the survey of about 125 miles of aqueduct locations, extending from the Jerome Park Reservoir to Roeliff Jansen Kill, and comprising eighty miles of line for aqueduct, following the contour of the ground, and designed to be built of masonry in open trench, and covered by earth, about forty miles of tunnel, and about five miles of large steel-pipe siphons. The report goes on to say:

Near Stormville and Billings, on the upper Fishkill, reservoir sites of about 4½ and 2½ square miles have been surveyed, contoured, and plotted, and the capacities corresponding to various elevations of water surface computed. . . .

At Hibernia, on the upper Wappinger, surveys are being made of a promising site for a reservoir much larger than the new Croton reservoir, requiring one main dam and a dike. . . .

Near Clinton Hollow, about twelve miles northeast of Poughkeepsie, on the upper Wappinger, surveys for a high-level reservoir have been begun, and will require about six weeks for completion.

Near Silvernails, on the upper Roeliff Jansen Kill, about twenty-five miles northeast of Poughkeepsie, an excellent site for a high-level reservoir, covering about nine square miles, has been surveyed, contoured, and plotted, with dam site plans in detail. These plans and estimates are well advanced toward completion.

Surveys of large terminal reservoirs have been made, and a contour plotting completed ready for studies of excavation and embankments and estimates of cost.

LOW-LEVEL RESERVOIR STUDIES.

In connection with the low-level aqueduct lines, extensive surveys covering seventeen square miles have been made of a possible site for a great reservoir near Fishkill, and a large portion of the work is plotted. . . .

On the Wappinger, surveys covering ten square miles have been made for a low-level reservoir, and several dam sites have been studied. Contour plans of this reservoir site have been drawn.

Other surveys have been made in an extended study of other possibilities for large reservoir sites at suitable elevations east of the Hudson River, by means of the maps of the United States Geological Survey and reconnoissance in the field. Comparative designs and estimates have been made to determine the best and most economical sections for aqueducts and tunnels, the best methods of tunnel lining, and other structural details, from which close estimates of cost will be soon made or from which contract drawings may be prepared.

DIVERSION DAMAGES.

The data for estimates of damage to water powers and factory sites on each of the streams where a diversion of water is proposed have been collected. Nearly every factory has been visited and notes made of its water fall, power, and use of water. The estimates of money value of damage sustained by the diversion have as yet been only approximated, but at what is thought to be an outside amount.

THE CATSKILL DEPARTMENT.

The Catskill Department was organized early in March. The principal work of this department has been done in the Esopus valley, but it extended into the upper portions of the Schoharie and Catskill valleys. The surveys made two years ago under the former Department of Water Supply were availed of as far as possible.

Surveys in much detail have shown that near Bishop's Falls on the Esopus a dam can be built higher than heretofore supposed practicable, which will flood an area of more than fourteen square miles and form a storage reservoir of more than double the available capacity of the new Croton reservoir when completed, and of admirable form for holding the water several months in storage in transit from the river to the aqueduct, thus favoring purification, sedimentation, bleaching, and destruction of pathogenic germs. . . .

The Ulster & Delaware Railroad runs through this reservoir site, and two alternative surveys for its relocation, comprising twenty-eight miles of location have been run with such full detail that quantities and costs can be closely estimated. . . .

Other reservoir sites in the Esopus valley have been located at Cold Brook, Lake Hill, Wittenburg, Shandaken, and Big Indian.

A tunnel line thirteen miles long, crossing under the Catskill range from the Schoharie watershed into the Esopus valley, has been reconnoitered and surveyed, and stadia surveys have been made of four reservoir and dam sites in the upper Schoharie watershed on the northwestern slopes of the Catskill Mountains, available for supplementing the Esopus in the near future.

RAINFALL STUDIES.

Much study has been given to the rainfall of the Catskill Mountain region to determine its volume in comparison with that of the Croton watershed. . . . The indications are that it is materially larger, but the observations and studies so far made are not extended enough to warrant conclusions, and like many other series of meteorological and hydrographic observations begun by this Commission, should be taken in charge by the regular engineering staff of the Department of Water Supply, Gas, and Electricity, and continued for a series of years.

FILTRATION DEPARTMENT.

Filtration projects suitable for each of four independent schemes have been worked out covering all the projects for upland and Hudson River waters and for the filtration of the Croton supply.

Studies for improved methods of handling the sand and otherwise lessening the cost are now well advanced, designs of standard details such that full working drawings can be promptly made for filter construction are now in preparation, and a close estimate of cost will follow.

We hope to be able on November 15 to present complete plans for a first installment of filters, of fifty million gallons per day capacity.

CHEMICAL AND BIOLOGICAL DEPARTMENT.

This department was organized to be in readiness to collect samples of the winter or spring flood waters in all streams available for water supply. . . . Between January 1 and September 1, over 4,000 samples of water had been collected and examined. . . .

INVESTIGATION OF THE PRESENT SUPPLY.

Croton water has often been turbid during the past few years and occasionally malodorous, but nevertheless appears to be generally satisfactory from a sanitary standpoint. The odors are due not to pollution, but to the effect of microscopic organisms which grow at certain seasons in the reservoirs and especially in the distributing reservoirs in Central Park. The unsatisfactory physical condition of the Croton water has led to the expenditure by citizens of hundreds of thousands of dollars in household filters, stills, etc., and to large annual expenditures for spring water, all of which would be rendered unnecessary by public filtration.

The Brooklyn water has also been carefully studied. It is generally clear, but occasionally turbid after heavy rains.

The hardness of both the Croton and the Long Island water averages about 40 by the ordinary scale, but the Brooklyn water is somewhat less desirable than the Croton for steam boilers, because of the infiltration of sea water into some of the driven wells near the shore. The population in some portions of the watershed now drawn on is rapidly increasing and the surface supplies, from brooks and streams, are being exposed to increasing dangers from pollution.

SANITARY STUDIES FOR THE ADDITIONAL SUPPLY.

The waters of the Rondout and Esopus are of excellent quality, being light-colored and very soft. . . . Filtration would render this water well-nigh perfect for purposes of public supply. The water of the Catskill Creek has been found clearer than that of the Esopus, but it contains more calcareous matter, and has a hardness which exceeds that of the Croton. The water of the Schoharie Creek is soft and has little color.

The Roeliff Jansen Kill, Wappinger Creek, and Fishkill Creek are practically unpolluted, clear, tasteless, odorless, and with low color, but somewhat hard at times. . . .

HUDSON RIVER WATER.

The average of many analyses shows that the hardness of the water at the proposed future intake between Greer Point and Hyde Park would be substantially the same as that taken from this river at Albany, and that this water could be made at least

equally satisfactory by filtration. The additional pollution received below Albany is more than offset by dilution from the volume of water received from tributaries entering below.

The pollution of the Hudson was carefully studied statistically by making estimates of the city and country population per square mile at various selected points between Glens Falls and New York harbor, and by ascertaining the typhoid statistics of all the cities along its course, the amount of sewage and factory waste. By adopting proper precautions the water between Poughkeepsie and Hyde Park would be rendered perfectly safe for domestic use. It would have an average hardness probably a little greater than that of the present Croton supply. The limit of upflow of salt water in the Hudson never extends up the river beyond Greer Point even in the driest year.

PREPARING THE MOLD.

THE MODERN CRAFT OF METAL WORKING.*

By Day Allen Willey.

The fashioning of bronze, iron, and other metals into ornamental work in this country has made such remarkable progress that throughout the United States can be seen productions which are of a very high artistic standard. The development which has been attained in the manufacture of metal gateways and doorways, tablets containing inscriptions and other designs, protective work for banking offices, stairways in public buildings and hotels, lampposts, and even metal columns used in architectural work give evidence of the skill which has been attained by the American workman in this branch of industry. Apparently the artistic idea is being developed in the molder and finisher as well as in the pattern maker who adapts the bronze and iron to the size and shape of the drawing of the expert. Even the novice can distinguish the superiority of design and finish shown in recent work compared with that which was done only a few years ago.

It is believed that the methods employed to-day are very similar to those by which the metal artists among the ancients produced the wonderful works which have been brought to light by excavation, with the exception that they had the advantage of but little labor-saving machinery and worked with hand tools of a far different pattern. The foundry was as essential as it is to-day, although destitute of the traveling cranes and other forms of power apparatus for carrying the metal required for casting gigantic statuary and other designs and for moving pieces from one place to another.

Such is the variety of productions of the kind referred to that the United States contains some very extensive works devoted entirely to manufacturing objects, ranging from parlor bric-a-brac to statues, and other pieces weighing several tons; consequently a very elaborate series of processes is employed from the time the drawing is made until the metal receives its finishing touches. The foundry of one of these plants is similar in many respects to the ordinary iron foundry with its flasks, sand and other compounds, and furnaces, but scattered about are busts, heads, and other portions of the body reproduced in metal, as well as pieces of figures of animals, mythological groups, etc., which, perhaps an hour before, were pigs of bronze and iron. The mold is made in various ways, depending principally upon the size of the object to be reproduced. One plan followed is to coat the model with wax, then with a compound composed of clay, ground brick, or potters' slip. In some works, sand is packed about the models in an iron molder's flask, as shown in the illustration, which represents the making of the mold of a bronze grille. After the mold has been completed, it is placed in the furnace and the wax or other soluble matter melts and escapes through holes purposely left in the framework to be displaced by the melted bronze or iron. Where small objects are to be formed, the mold is frequently formed of wax or clay, then cast in plaster of Paris, after which a casting is made of an alloy which is used for the pattern. The casting of the smaller designs is done by hand, for two men can manipulate a pot holding one hundred pounds of metal under ordinary conditions. For heroic figures and other pieces of large size, the foundry is provided with electric or compressed-air hoisting machinery for lifting the pots from the furnace. In the John Williams Foundry, which is illustrated in the accompanying photographs, a compressed-air hoist is utilized. The pots are transferred to the molds by an overhead trolley system, the plan being somewhat similar to that utilized in the handling of Bessemer steel converters.

The next process is the preparation of the casting for filing and chasing. It is cleaned and dipped in acid to remove all foreign substances which may adhere to the surface, so that the ornamentation can be brought out by means of special tools. It is in this department that the artistic skill of the workman is strikingly displayed, for he literally perfects a picture with his chisels, mats, and riffles, elaborating details which cannot be completely brought out in the casting.

The work is then taken to the fitting and assembling department, where the pieces which comprise the designs are sorted and fitted and bolted together. Again delicacy of workmanship is required in finishing the edges so that a perfect fit will result, an operation which requires not only time and patience but the use of a variety of tools. In what is known as the wrought-iron department, the various members of grilles, gates, stair-rails, etc., are fitted and fastened frequently in such a manner that apparently the entire design has been cut in one piece, when as a matter of fact it may represent a dozen or a score of sections. The designs of flowers and leaves in metal, which are so popular, are usually hand forged and fastened to the scroll and other work by rivets placed beneath the ornaments or adjusted in other ways so that they are practically invisible.

LIFTING POTS OF MOLTEN BRONZE FROM FURNACES.

In addition to the processes mentioned, however, figures which require a polish are taken into a department provided with power wheels especially for this purpose. Much of the metal used in the interior of buildings is given a gloss for decorative purposes, which gloss is fixed by treating the surface to a coating of lacquer. In ornamenting metal a number of hues are utilized, such as bronze-verde, giving it an antique appearance, what is known as oxidized statuary bronze, etc. These compounds are applied in liquid form, and if the work is properly done the coating will last for years under ordinary conditions.

*Specially prepared for the Scientific American Supplement.

Correspondence.

RADIO-ACTIVITY—THE SECRET OF RADIUM'S LIGHT AND HEAT.

To the Editor of the Scientific American:

In the New York papers of to-day, under the head of "Secret of Radium Heat," appears a cable dispatch from London, stating that Lord Kelvin suggests it may be supplied by ethereal waves. It appears, quoting from the dispatch, that:

"At a meeting of the science branch of the British Association, Lord Kelvin, in a paper which he read made an interesting suggestion in connection with its perpetual emission of heat, at, according to M. Curie's calculation, a rate of about 90 Centigrade calories per gramme per hour.

"He said that if the emission of heat at this rate went on for 10,000 hours, there would be as much heat as would raise the temperature of 900,000 grammes of water 1 degree Centigrade. It seemed utterly impossible to Lord Kelvin that this would come from the store of energy lost out of a gramme of radium in 10,000 hours. It seemed, therefore, absolutely certain that the energy must somehow be supplied from without. He suggested that ethereal waves might in some way supply energy to radium while it was emitting heat to matter around it.

"Lord Kelvin illustrated his theory by the following comparison: Suppose a piece of white and a piece of black cloth, hermetically sealed in similar glass cases, were submerged in similar glass vessels of water and exposed to the sun. The water in the vessel containing the black cloth would be kept very sensibly warmer than that containing the white cloth. Here the thermal energy was communicated to the black cloth by waves of sunlight, and was given out as thermometric heat to the water in the glass around it. Thus through the water there was actually an energy traveling inward in virtue of the waves of light and outward through the same space in virtue of thermal conduction.

"Lord Kelvin suggested that experiments be made comparing the heat emission from radium wholly surrounded with thick lead with that found in the surroundings heretofore used."

Two years ago I wrote an article entitled "Celestial Explosions and Their Relation to Electrical Phenomena," which appeared in the Electrical Age, January, 1902, in which article I advanced the same theory to account for the radio-activity of radium, uranium, pitchblende, etc., that has just been advanced by Lord Kelvin. Also, in Success, of October, 1902, under the title "The Light of the Future," I again advanced the theory that radio-active substances derive their active properties from high etheric vibrations emanating from a source external of the radio-active substances, which, impinging upon these substances, are converted into vibrations of a lower pitch, corresponding to what we know as heat and light.

In my article in the Electrical Age, I said:

"We have lately read much about the light-giving properties of uranium and its compounds, and of radium, polonium, and pitchblende. What is the cause of this luminosity? Is it not possible that these metals or compounds owe their light-giving properties to peculiar susceptibility to certain ether waves which reach us from the sun; and which, having a very high rate of vibration, ordinary matter does not offer sufficient impediment to produce a luminous effect? These compounds, by arresting the ether corpuscles, give them a lower rate of vibration, and one which corresponds with that of light.

"We, upon the surface of the earth, while basking in the unobstructed rays of sunlight, have been in the habit of thinking that the denizens of the ocean deeps were denied such a privilege, and that they were doomed to infinite and eternal night. Recent investigation, however, has shown that the forms of life which swarm in the greatest ocean deeps have eyes and see by a sort of self-created phosphorescent light. They are provided both with eyes and a light-giving

apparatus. Is it not possible—may it not even be probable—that there are etheric waves emanating from the sun which penetrate to the greatest ocean depths as readily as ordinary light penetrates our atmosphere? And it requires but a specially constructed etheric wave condenser or arrester carried upon the heads of

POURING MOLTEN BRONZE INTO MOLDS.

deep-sea animals, in order to emit the necessary light to give them a clear view of their surroundings.

"It appears that Nature has been unable to create visual organs capable of responding to etheric vibrations higher in pitch than that of violet light. Hence, the X-rays cannot be seen. Animals living upon the earth's surface have but little need of visual organs adapted to see by etheric vibrations of a higher pitch than that of sunlight. But animals living in the deep sea, far below the reach of the smallest ray of sunshine, as we know it, still have visual organs. Therefore, light must be provided, and to meet this demand, I will advance the theory that Nature has provided organs for collecting the etheric vibrations such as do penetrate to those depths, and which slow them down to a rate which renders them visible."

In my article in Success, above referred to, I dealt with the subject more at length, in the following terms:

"The newly-discovered bodies, uranium, radium, polonium, and pitchblende, which give light in the dark,

CHASING DEPARTMENT.

awaken our curiosity and wonder. That a body placed in an absolutely dark room should emit light, of its own accord, challenges extraordinary attention; for, however small in quantity, we know that light represents energy, and that energy is uncreatable, indestructible, and eternal, just as matter is. Therefore, we know that the energy which this body gives out in the form of light must be supplied from some exterior source.

"We have already been taught by science that our senses do not make us conscious of all natural phenomena. We know that there are sounds too high in pitch for us to hear—that the ear cannot distinguish sound produced by vibrations greater in number than forty thousand per second. We know that our visual organs are not constituted to respond to rays of light below the red, or above the violet, but we know that there are other rays, as certainly as if we were made conscious of them in the same way that we are conscious of ordinary light. The X-ray, which was discovered by the photographic plate, represents a vibratory pitch beyond our visual powers. Had we visual organs sufficiently sensitive, the Crookes tube would emit a most brilliant white light. Had we visual organs capable of responding to ether vibrations very low in pitch, we might be able to see by means of the heat rays emitted from the bricks of an ordinary chimney. But Nature appears to have been able to provide visual organs capable only of responding to ether vibrations within a limited range.

"The eyes of the owl are specially constructed for gathering and concentrating feeble rays of light, but still it is light as we know it. His eyes, however, should reasonably have been made to see with ether vibrations of a higher pitch, had such an expedient been possible.

"In the great ocean depths, where all light is excluded and utter darkness reigns, eyes like those of the owl could gather no light; still, the inhabitants of those deeps are provided with visual organs, which are constructed to see with ordinary light. To meet this need, Nature has provided the deep-sea animals with light-giving organs by which they are enabled to illuminate and render visible the objects in the otherwise utter darkness about them. Fish that inhabit the waters of deep caverns in the earth, however, have no eyes, although there the darkness is no more utter than it is in the deep seas. This leads us to the hypothesis that there are certain etheric vibrations which are capable of penetrating the waters of the ocean in the same manner that ordinary light penetrates our atmosphere, and that these high vibrations, falling upon the light-giving apparatus of the deep-sea animals, are transformed into vibrations of a lower order, corresponding with phosphorescent light, and that the intervening earth and rock prevent the same rays penetrating to the inhabitants of the waters of caves; otherwise they, too, would be provided with eyes and with similar light-giving apparatus. The firefly and the glow-worm are terrestrial representatives of the autoluminescent principle employed by Nature in providing light to the denizens of the deep seas.

"We are all familiar with the fact that sunlight passing through a pane of clear, transparent glass scarcely warms it, and would not warm it at all were it perfectly transparent. If, however, we paint the glass with lampblack, it becomes very quickly heated. The reason for this is that the rays of light, on striking the blackened surface, are slowed down to a vibration of a much lower pitch, and this is what we know as heat. If our eyes were constructed to see by heat rays, we should be unable to see by ordinary light, and ordinary light would then be unsuited to our eyes, the same as the X-rays now are, and it would be necessary for light rays to be converted into heat rays before they would be visible to us, the same as those invisible rays which, striking upon uranium, radium, polonium, and pitchblende, cause those bodies to emit light. In like manner we must account for the light-giving properties of these bodies. It is the theory of the writer that high etheric vibrations beyond the range of our vision, impinging upon the surfaces of these bodies, are slowed down to a lower pitch, which corresponds with light as we know it, in the same manner that ordinary light, striking an opaque body, causes the body to emit heat.

"Similarly, as ordinary light passes through transparent bodies without heating them, while it causes opaque bodies to emit heat, the ether vibrations of a higher pitch than light pass through ordinary bodies without rendering them luminous; but, when they strike bodies which to them are opaque, a luminous effect is produced. In other words, in the opinion of the writer, it is the property of opacity to high etheric vibrations which renders radium, polonium, and pitchblende phosphorescent or light-giving.

"In the same manner that rays of light from the sun, on a hot summer day, falling upon a black hat, heat it, so, the writer believes, do high ether vibrations, falling upon the light-giving headgear of submarine animals, render them luminous. If our eyes were constituted to see by rays of heat, and not by light, then a black hat in summer time would be a crown of light and illuminate our pathway. It is probable, however, that the luminous organs of deep-sea animals possess the property of concentrating the high etheric vibrations, as well as of transforming them; and, if our sun were many times more dim than it now is, and we were to wear upon our heads both a black crown and a sunglass for concentrating the light upon the black surface of the crown, we should be provided with an apparatus for seeing with heat rays somewhat comparable with the phosphorescent organs with which deep-sea animals are provided for transforming non-luminous into luminous vibrations."

As another illustration of my theory—if sunlight be passed through a diffraction grating, separating out all except the ultra-violet rays, and if a cube of uranium oxide glass be held in the violet rays, the ultra-violet light is converted into green light, and is changed from a light which cannot be seen to a visible light. This is exactly what radium does. It converts ultra-visual light into phosphorescent light which we can see.

Hudson Maxim.

September 13, 1903.

A CORRECTION.

Referring to the article published in the Supplement of September 5, regarding the attaching of a wooden face to a cast-iron pulley, we beg to state that although the contract was taken by Patterson, Gottfried & Hunter, the work was designed and executed by the Reeves Pulley Company, of Columbus, Ind.

THE INFLUENCE OF BRAIN-POWER ON HISTORY.*

SIR NORMAN LOCKYER'S PRESIDENTIAL ADDRESS TO THE BRITISH ASSOCIATION.

The progress of science brings in many considerations which are momentous in relation to the life of any limited community—any one nation. One of these considerations to which attention is now being greatly drawn is that a relative decline in national wealth derived from industries must follow a relative neglect of scientific education. It was the late Prince Consort who first emphasized this when he came here fresh from the University of Bonn. Hence the "Prince Consort's Committee," which led to the foundation of the College of Chemistry, and afterward of the Science and Art Department. From that time to this the warnings of our men of science have become louder and more urgent in each succeeding year. But this is not all; the commercial output of one country in one century as compared with another is not alone in question; the acquirement of the scientific spirit and a knowledge and utilization of the forces of Nature are very much further reaching in their effects on the progress and decline of nations than is generally imagined.

Britain in the middle of the last century was certainly the country which gained most of the advent of science, for she was then in full possession of those material gifts of Nature, coal and iron. Being the great producers and exporters of all kinds of manufactured goods, we became eventually, with our iron ships, the great carriers, and hence the supremacy of our mercantile marine and our present command of the sea. The first great effect of the general progress of science was relatively to diminish the initial supremacy of Britain due to the first use of material sources, which, indeed, was the real source of our national wealth and place among the nations. The unfortunate thing was that, while the foundations of our superiority depending upon our material resources were being thus sapped by a cause which was beyond our control, our statesmen and our universities were blind leaders of the blind, and our other asset, our mental resources, which was within our control, was culpably neglected.

So little did the bulk of our statesmen know of the part science was playing in the modern world and of the real basis of the nation's activities that they imagined political and fiscal problems to be the only matters of importance. Nor, indeed, are we very much better off to-day. In the important discussions recently raised by Mr. Chamberlain next to nothing has been said of the effect of the progress of science on prices. The whole course of the modern world is attributed to the presence or absence of taxes on certain commodities in certain countries. The fact that the great fall in the price of food-stuffs in England did not come till some thirty or forty years after the removal of the corn duty between 1847 and 1849 gives them no pause; for them, new inventions, railways and steamships are negligible quantities; the vast increase in the world's wealth, in free trade and protected countries alike, comes merely, according to them, in response to some political shibboleth.

We now know, from what has occurred in other states, that if our Ministers had been more wise and our universities more numerous and efficient, our mental resources would have been developed by improvements in educational method, by the introduction of science into schools, and, more important than all the rest, by the teaching of science by experiment, observation and research, and not from books. It is because this was not done that we have fallen behind other nations in properly applying science to industry, so that our applications of science to industry are relatively less important than they were. But this is by no means all; we have lacked the strengthening of the national life produced by fostering the scientific spirit among all classes and along all lines of the nation's activity; many of the responsible authorities know little and care less about science; we have not learned that it is the duty of a state to organize its forces as carefully for peace as for war; that universities and other teaching centers are as important as battleships or big battalions—are, in fact, essential parts of a modern state's machinery, and, as such, to be equally aided and as efficiently organized to secure its future well-being.

Now the objects of the British Association, as laid down by its founders seventy-two years ago, are: "To give a stronger impulse and a more systematic direction to scientific inquiry; to promote the intercourse of those who cultivate science in different parts of the British Empire with one another and with foreign philosophers; to obtain a more general attention to the objects of science and a removal of any disadvantages of a public kind which impede its progress." In the main, my predecessors in this chair, to which you have done me the honor to call me, have dealt, and with great benefit to science, with the objects first named. But at a critical time like the present I find it imperative to depart from the course so generally followed by my predecessors and to deal with the last object named, for, unless by some means or other we "obtain a more general attention to the objects of science and a removal of any disadvantages of a public kind which impede its progress," we shall suffer in competition with other communities in which science is more generally utilized for the purposes of the national life.

What is wanted is a complete organization of the resources of the nation, so as to enable it best to face all the new problems which the progress of science, combined with the ebb and flow of population and other factors in international competition, are ever bringing before us. Every minister, every public department, is involved; and this being so, it is the duty of the whole nation—King, lords, and commons—to do what is necessary to place our scientific institutions on a proper footing in order to enable us to "face the music," whatever the future may bring. The idea that science is useful only to our industries comes from want of thought. If anyone is under the impression that Britain is only suffering at present from the want of scientific spirit among our industrial classes, and that those employed in the state service possess adequate brain-power and grip of the conditions of the modern world into which science so largely enters, let him read the Report of the Royal Commission on the War in South Africa.

The present condition of the nation, so far as its industries are concerned, is as well known, not only to the Prime Minister, but to other political leaders in and out of the Cabinet, as it is to you and to me. Let me refer to two speeches delivered by Lord Rosebery and Mr. Chamberlain on two successive days in January, 1901.

Lord Rosebery spoke as follows:

" . . . The war I regard with apprehension is the war of trade which is unmistakably upon us. . . . When I look round me I cannot blind my eyes to the fact that, so far as we can predict anything of the twentieth century on which we have now entered, it is that it will be one of acutest international conflict in point of trade. We were the first nation of the modern world to discover that trade was an absolute necessity. For that we were nicknamed a nation of shopkeepers; but now every nation wishes to be a nation of shopkeepers too, and I am bound to say that when we look at the character of some of these nations, and when we look at the intelligence of their preparations, we may well feel that it behooves us not to fear, but to gird up our loins in preparation for what is before us."

Mr. Chamberlain's views were stated in the following words:

"I do not think it is necessary for me to say anything as to the urgency and necessity of scientific training. . . . It is not too much to say that the existence of this country, as the great commercial nation, depends upon it. . . . It depends very much upon what we are doing now, at the beginning of the twentieth century, whether at its end we shall continue to maintain our supremacy or even equality with our great commercial and manufacturing rivals."

All this refers to our industries. We are suffering because trade no longer follows the flag as in the old days, but because trade follows the brains, and our manufacturers are apt to be careless in securing them. In one chemical establishment in Germany, four hundred doctors of science, the best the universities there can turn out, have been employed at different times in late years. In the United States the most successful students in the higher teaching centers are snapped up the moment they have finished their course of training, and put into charge of large concerns, so that the idea has got abroad that youth is the password of success in American industry. It has been forgotten that the latest product of the highest scientific education must necessarily be young, and that it is the training and not the age which determines his employment. In Britain, on the other hand, apprentices who can pay high premiums are too often preferred to those who are well educated, and the old rule-of-thumb processes are preferred to new developments—a conservatism too often depending upon the master's own want of knowledge.

I should not be doing my duty if I did not point out that the defeat of our industries one after another, concerning which both Lord Rosebery and Mr. Chamberlain express their anxiety, is by no means the only thing we have to consider. The matter is not one which concerns our industrial classes only, for knowledge must be pursued for its own sake; and since the full life of a nation with a constantly increasing complexity, not only of industrial, but of high national aims, depends upon the universal presence of the scientific spirit—in other words, brain-power—our whole national life is involved.

The present awakening in relation to the nation's real needs is largely due to the warnings of men of science. But Mr Balfour's terrible Manchester picture of our present educational condition* shows that the warning, which has been going on now for more than fifty years, has not been forcible enough. During many years it has been part of my duty to consider such matters, and I have been driven to the conclusion that our great crying need is to bring about an organization of men of science, and all interested in science, similar to those which prove so effective in other branches of human activity. For the last few years I have dreamt of a chamber, guild, league—call it what you will—with a wide and large membership, which should give us what, in my opinion, is so urgently needed. Quite recently I sketched out such an organization, but what was my astonishment to find that I had been forestalled, and by the founders of the British Association!

At the commencement of this address I pointed out that one of the objects of the Association, as stated by its founders, was "to obtain a more general attention to the objects of science and a removal of any disadvantages of a public kind which impede its progress." Everyone connected with the British Association from its beginning may be congratulated upon the magnificent way in which the other objects of the Association have been carried out; but as one familiar with the Association for the last forty years I cannot but think that the object to which I have specially referred has been too much overshadowed by the work done in connection with the others.

A careful study of the early history of the Association leads me to the belief that the function I am now dwelling on was strongly in the minds of the founders; but be this as it may, let me point out how admirably the organization is framed to enable men of science to influence public opinion and so to bring pressure to bear upon governments which follow public opinion: (1) Unlike all the other chief metropolitan societies, its outlook it not limited to any branch or branches of science. (2) We have a wide and numerous fellowship, including both leaders and the lovers of science, in which all branches of science are and always have been included with the utmost catholicity—a condition which renders strong committees possible on any subject. (3) An annual meeting at a time when people can pay attention to the deliberations and when the newspapers can print reports. (4) The possibility of beating up recruits and establishing local committees in different localities, even in the King's dominions beyond the seas, since the place of meeting changes from year to year and is not limited to these islands.

We not only, then, have a scientific parliament competent to deal with all matters, including those of national importance, relating to science, but machinery for influencing all new councils and committees dealing with local matters, the functions of which are daily becoming more important. The machinery might consist of our corresponding societies. We already have affiliated to us 70 societies with a membership of 25,000. Were this number increased so as to include every scientific society in the empire, metropolitan and provincial, we might eventually hope for a membership of half a million. I am glad to know that the council is fully alive to the importance of giving a greater impetus to the work of the corresponding societies. During this year a committee was appointed to deal with the question; and later still, after this committee had reported, a conference was held between this committee and the corresponding societies' committee to consider the suggestions made, some of which will be gathered from the following extract:

"In view of the increasing importance of science to the nation at large, your committee desire to call the attention of the Council to the fact that in the corresponding societies the British Association has gathered in the various centers represented by these societies practically all the scientific activity of the provinces. The number of members and associates at present on the list of the corresponding societies approaches 25,000, and no organization is in existence anywhere in the country better adapted than the British Association for stimulating, encouraging, and co-ordinating all the work being carried on by the 70 societies at present enrolled. Your committee are of opinion that further encouragement should be given to these societies and their individual working members by every means within the power of the Association; and with the object of keeping the corresponding societies in more permanent touch with the Association they suggest that an official invitation on behalf of the Council be addressed to the societies, through the corresponding societies' committee, asking them to appoint standing British Association sub-committees, to be elected by themselves, with the object of dealing with all those subjects of investigation common to their societies and to the British Association committees, and to look after the general interests of science and scientific education throughout the provinces and provincial centers. . . .

"Your committee desire to lay special emphasis on the necessity for the extension of the scientific activity of the corresponding societies and the expert knowledge of many of their members in the direction of scientific education. They are of opinion that immense benefit would accrue to the country if the corresponding societies would keep this requirement especially in view with the object of securing adequate representation for scientific education on the education committees now being appointed under the new act. The educational section of the Association having been but recently added, the corresponding societies have as yet not had much opportunity for taking part in this branch of the Association's work; and in view of the reorganization in education now going on all over the country, your committee are of opinion that no more opportune time is likely to occur for the influence of scientific organizations to make itself felt as a real factor in national education. . . ."

I believe that if these suggestions or anything like them—for some better way may be found on inquiry—are accepted, great good to science throughout the empire will come. Rest assured that sooner or later such a guild will be formed, because it is needed. It is for you to say whether it shall be, or form part of, the British Association. We in this empire certainly need to organize science as much as in Germany they find the need to organize a navy. The German Navy League, which has branches even in our colonies, already has a membership of 630,000, and its income is nearly £20,000 a year. A British Science League of 500,000 with a sixpenny subscription would give us £12,000 a year, quite enough to begin with.

I, for one, believe that the British Association would be a vast gainer by such an expansion of one of its existing functions. Increased authority and prestige would follow its increased utility. The meetings would possess a new interest; there would be new subjects for reports; missionary work less needed than formerly would be replaced by efforts much more suited to the real wants of the time. This magnificent, strong, and complicated organization would become a living force, working throughout the year instead of practically lying idle, useless and rusting for 51 weeks out of the 52 so far as its close association with its members is concerned.

If this suggestion in any way commends itself to you, then when you begin your work in your sections or general committee see to it that a body is appointed to inquire how the thing can be done. Remember that the British Association will be as much weakened by the creation of a new body to do the work I have shown to have been in the minds of its founders as I believe it will be strengthened by becoming completely effective in every one of the directions they indicated, and for which effectiveness we, their successors, are indeed responsible. The time is appropriate for such a reinforcement of one of the wings of our organization, for we have recently included education among our sections.

There is another matter I should like to see referred to the committee I have spoken of, if it please you to appoint it. The British Association—which, as I have already pointed out, is now the chief body in the empire which deals with the totality of science—is, I believe, the only organization of any consequence which is without a charter, and which has not His Majesty the King as patron.

I suppose it is my duty, after I have suggested the need of organization, to tell you my personal opinion

* Delivered at Southport September 9, 1903.—Abstract.

* The existing educational system of this country is chaotic, is ineffectual, is utterly behind the age, makes us the laughing-stock of every advanced nation in Europe and America, puts us behind, not only our American cousins, but the German and the Frenchman and the Italian.—The Times, October 15, 1902.

as to the matters where we suffer most in consequence of our lack of organization at the present time. Our position as a nation, our success as merchants, are in peril chiefly—dealing with preventable causes—because of our lack of completely efficient universities and our neglect of research. This research has a double end. A professor who is not learning cannot teach properly or arouse enthusiasm in his students; while a student of anything who is unfamiliar with research methods, and without that training which research brings, will not be in the best position to apply his knowledge in after life. From neglect of research comes imperfect education and a small output of new applications and new knowledge to reinvigorate our industries. From imperfect education comes the unconcern touching scientific matters and the too frequent absence of the scientific spirit in the nation generally, from the court to the parish council. I propose to deal as briefly as I can with each of these points.

I have shown that, so far as our industries are concerned, the cause of our failure has been run to earth; it is fully recognized that it arises from the insufficiency of our universities both in numbers and efficiency, so that not only our captains of industry, but those employed in the nation's work generally, do not secure a training similar to that afforded by other nations. No additional endowment of primary, secondary, or technical instruction will mend matters. This is not merely the opinion of men of science; our great towns know it, our ministers know it.

Our conception of a university has changed. University education is no longer regarded as the luxury of the rich, which concerns only those who can afford to pay heavily for it. The prime minister in a recent speech, while properly pointing out that the collective effect of our public and secondary schools upon British character cannot be over-rated, frankly acknowledged that the boys of seventeen or eighteen who have to be educated in them "do not care a farthing about the world they live in except in so far as it concerns the cricket-field or the football-field or the river." On this ground they are not to be taught science; and hence, when they proceed to the university, their curriculum is limited to subjects which were better taught before the modern world existed, or even Galileo was born. But the science which these young gentlemen neglect, with the full approval of their teachers, on their way through the school and the university to politics, the civil service, or the management of commercial concerns, is now one of the great necessities of a nation; and our universities must become as much the insurers of the future progress as battleships are the insurers of the present power of states. In other words, university competition between states is now as potent as competition in building battleships; and it is on this ground that our university conditions become of the highest national concern, and therefore have to be referred to here, and all the more because our industries are not alone in question.

Chief among the causes which have brought us to the terrible condition of inferiority as compared with other nations in which we find ourselves are our carelessness in the matter of education and our false notions of the limitations of state functions in relation to the conditions of modern civilization. We in Great Britain have 13 universities competing with 134 state and privately-endowed in the United States and 22 state-endowed in Germany. The German state gives to one university more than the British government allows to all the universities and university colleges in England, Ireland, Scotland, and Wales put together. These are the conditions which regulate the production of brain-power in the United States, Germany, and Britain respectively, and the excuse of the government is that this is a matter for private effort. Do not our ministers of state know that other civilized countries grant efficient state aid, and, further, that private effort has provided in Great Britain less than ten per cent of the sum thus furnished in the United States in addition to state aid? Are they content that we should go under in the great struggle of the modern world because the ministries of other states are wiser, and because the individual citizens of another country are more generous than our own?

If we grant that there was some excuse for the state's neglect so long at the higher teaching dealt only with words, and books alone had to be provided (for the streets of London and Paris have been used as class-rooms at a pinch), it must not be forgotten that during the last one hundred years not only has knowledge been enormously increased, but things have replaced words, and fully equipped laboratories must take the place of books and class rooms if university training worthy of the name is to be provided. There is much more difference in size and kind between an old and a new university than there is between the old caravel and a modern battleship, and the endowments must follow suit.

What are the facts relating to private endowment in this country? In spite of the munificence displayed by a small number of individuals in some localities, the truth must be spoken. In depending in our country upon this form of endowment we are trusting to a broken reed. If we take the twelve English university colleges, the forerunners of universities unless we are to perish from lack of knowledge, we find that private effort during sixty years has found less than £4,000,000—that is, £2,000,000 for buildings, and £40,000 a year income. This gives us an average of £166,000 for buildings, and £3,300 for yearly income. In the United States, during the last few years, universities and colleges have received more than £40,000,000 from this source alone; private effort supplied nearly £7,000,000 in the years 1898-1900.

Next consider the amount of state aid to universities afforded in Germany. The buildings of the new University of Strassburg have already cost nearly a million—that is, about as much as has yet been found by private effort for buildings in Manchester, Liverpool, Birmingham, Bristol, Newcastle, and Sheffield. The government annual endowment of the same German university is more than £49,000.

This is what private endowment does for us in England, against state endowment in Germany. But the state does really concede the principle; its present contribution to our universities and colleges amounts to £155,600 a year. No capital sum, however, is taken for buildings. The state endowment of the University of Berlin in 1891-2 amounted to £168,777.

When, then, we consider the large endowments of university education both in the United States and Germany, it is obvious that state aid only can make any valid competition possible with either. The more we study the facts, the more statistics are gone into, the more do we find that we to a large extent lack both of the sources of endowment upon one or other, or both, of which other nations depend. We are between two stools, and the prospect is hopeless without some drastic changes. And first among these, if we intend to get out of the present slough of despond, must be the giving up of the idea of relying upon private effort.

To compete on equal grounds with other nations, we must have more universities. But this is not all—we want a far better endowment of all the existing ones, not forgetting better opportunities for research on the part of both professors and students. Another crying need is that of more professors and better pay. Another is the reduction of fees; they should be reduced to the level existing in those countries which are competing with us—to, say, one-fifth of their present rates, so as to enable more students in the secondary and technical schools to complete their education. In all these ways facilities would be afforded for providing the highest instruction to a much greater number of students. At present there are almost as many professors and instructors in the universities and colleges of the United States as there are day students in the universities and colleges of the United Kingdom. Men of science, our leaders of industry, and the chiefs of our political parties all agree that our present want of higher education—in other words, properly equipped universities—is heavily handicapping us in the present race for commercial supremacy, because it provides a relatively inferior brain-power, which is leading to a relatively reduced national income.

The facts show that in this country we cannot depend upon private effort to put matters right. How about local effort? Anyone who studies the statistics of modern municipalities will see that it is impossible for them to raise rates for the building and upkeep of universities. The buildings of the most modern university in Germany have cost a million. For upkeep the yearly sums found, chiefly by the state, for German universities of different grades, taking the incomes of seven out of the twenty-two universities as examples, are:

First class	Berlin	£130,000
Second class ...	Bonn, Göttingen ...	56,000
Third class	Königsberg, Strassburg	48,000
Fourth class ...	Heidelberg, Marburg	37,000

Thus, if Leeds, which is to have a university, is content with the fourth-class German standard, a rate must be levied of 7d. in the pound for yearly expenses, independent of all buildings. But the facts are that our towns are already at the breaking strain. During the last fifty years, in spite of enormous increases in ratable values, the rates have gone up from about 2s. to about 7s. in the pound for real *local* purposes. But no university can be a merely local institution.

What, then, is to be done? Fortunately, we have a precedent admirably in point, the consideration of which may help us to answer this question. In old days our navy was chiefly provided by local and private effort. Fortunately for us those days have passed away; but some twenty years ago, in spite of a large expenditure, it began to be felt by those who knew that, in consequence of the increase of foreign navies, our sea power was threatened, as now, in consequence of the increase of foreign universities, our brain-power is threatened.

(To be continued.)

CONTEMPORARY ELECTRICAL SCIENCE.*

COHERERS.—As a result of a lengthy study of coherer phenomena, A. H. Taylor concludes that they may be divided into three classes corresponding to three stages in the condition of the contacts. First, there is a feeble leakage current across the contacts due to vapor conductivity. Second, the potential rises high enough to cause conduction by metallic ions. During considerable intervals of current the potential remains nearly constant, then rising by steps until the coherer reaches the third stage corresponding to curves of the type showing a gradual rise of potential. Upon further increase of potential gradient, conduction by metallic ions will take place, and hence the resistance will be much lowered. The P. D. is then that necessary to ionize at the nearest pair of contact elements. When there is a ballast resistance in circuit, a sudden rush of current would cause a sudden drop of potential which would check ionization. The potential will then remain very nearly constant until the first pair of surface elements is saturated with ions. Increased current can now be brought about only by increased ionic velocity, hence there comes a rise in potential until that necessary to ionize at the next pair of elements is reached. Then will ensue another interval of nearly constant potential, and the same thing will be repeated again. When all the spaces between elementary surfaces are saturated with ions, the coherer has reached stage three, and there will be a regular rise in potential until the contacts are welded together by the current, or brought firmly into contact by increased electrostatic attraction. The author believes that the so-called single-contact coherers have no practical existence.—A. H. Taylor, Phys. Rev., April, 1903.

IONS IN SOLUTION.—F. Kohlrausch works out, on the basis of the latest values of ionic velocities, a new hypothesis concerning electrolytic resistance. It is that every ion carries with it a mass of adhering solvent, which he calls its "atmosphere." The atmospheres of multivalent or compound ions differ from those of monatomic ions. The author thus attempts to reduce the properties of liquid ions to one fundamental element, viz., their hydration or power of forming atmospheres. He says: "Assuming as the single fundamental characteristic of each univalent monatomic ion the formation of a water atmosphere which varies according to the nature of the ion, the mobility of this complex on the one side and its temperature coefficient on the other, will be functions of these atmospheric formations, and therefore both quantities must hold functional relations to each other. We know too little of the molecular forces at present to attempt to describe this connection more exactly. But for the case in which the water shell is so thick that the ion exerts no force beyond it, the resistance to motion becomes simply a matter of water friction, which explains the fact that the most sluggish ions have nearly the same temperature coefficients as the viscosity. In the case of smaller aggregations we must remain content with the fact that we have at least the possibility of a fundamental explanation." If the electrolytic resistance is in reality a mechanical friction, it follows logically that the mobility of all the ions converges toward zero at about the same temperature, viz., 40 deg.—F. Kohlrausch, Proc. Roy. Soc., April 7, 1903.

VELOCITY OF ENERGY.—An ingenious application of the principle of the identity of energy is made by F. J. Rogers in calculating the velocity of its propagation along an electrical circuit and along a rotating shaft. Starting from Lord Kelvin's calculation of the energy of a "cubic mile of sunlight," the author puts the relationship between energy, power, and velocity into the equation $\frac{E}{V} = \frac{P/a}{v}$, where E/V is the energy per unit volume, P/a power transmitted by unit area and v the velocity of transmission. Solving this equation for v, we get $v = \frac{P/a}{E/V}$. In the case of concentric tubular conductors of small resistance, the equation assumes the form $v = \frac{P}{E/l}$, where P is the whole power and E/l is the energy per unit length stored in the dielectric between the two conductors. The maximum velocity comes out the same as the velocity of electromagnetic waves. In a rotating shaft, the velocity is a maximum when the kinetic and elastic energies are equal, and is then identical with the speed of a torsional wave. In a liquid the velocity equals that of a compressional wave.—F. J. Rogers, Phys. Rev., April, 1903.

BENDING OF ELECTRIC WAVES.—H. M. Macdonald shows mathematically that the conditions necessary for the formation of a shadow are much the same when an electric wave meets a conducting obstacle and when sound meets a rigid obstacle. The case theoretically worked out is that of a Hertzian oscillator placed outside a perfectly conducting sphere. The solution employs Bessel's functions and zonal harmonics. The author gives the amplitude of the electric force acting on a receiver placed at various angular distances round the earth. At an angular distance of 45 degrees, or rather more than 3,000 miles, the amplitude of the electric force acting on the receiver is more than half the amplitude of the electric force that would be directly due to the oscillator at that distance, and the intensity nearly three-tenths. These results will apply when the two places are separated by good conducting material such as sea water, the effect of the imperfect conduction of such substances being negligible. They explain why wireless telegraphy is more effective over the sea or wet soil than over dry soil. A badly-conducting obstacle diminishes the effect. It is also to be expected that the influence of a ridge of some sharpness between the places is to create a distinct shadow, to such an extent that the effect would be inappreciable; the same result would be produced by an intervening headland; this agrees with the experience of Captain Jackson.—H. M. Macdonald, Proc. Roy. Soc., March 14, 1903.

NEW ABSOLUTE ELECTROMETER.—E. Pasquini has devised an electrometer in which the movable plate is the top platform of a Fahrenheit hydrometer immersed in water. The guard ring lies on the rim of the water vessel. The stem of the hydrometer is 8 centimeters long, and the connection between the movable plate and the guard ring is made by means of a metallic fork attached to the stem, which prevents the hydrometer from rising further, and also acts as a guide. To make a measurement water is poured into the vessel until the movable plate is in the plane of the guard ring. After establishing the difference of potential to be measured, water is withdrawn until the hydrometer sinks. Then if h is the difference of water-level, $V_1 - V$ the difference of potential between the planes, then

$$V_1 - V = \frac{rD}{R}\sqrt{8\pi gh}$$

where h is the radius of the stem, R that of the movable disk, D the distance between the plates, and g the gravitational constant. Measurements of spark potentials up to 10 centimeters made with this instrument agree well with previous results.—E. Pasquini, Phys. Zeitschr., April 1, 1903.

ATMOSPHERIC CONDUCTIVITY.—From observations carried out on the summit of Mont Blanc by G. Le Cadet, it results that during fine weather the diurnal variation of atmospheric potential consists in a simple oscillation, with a maximum between 3 P. M. and 4 P. M., and a minimum about 3 A. M., thus closely following the variation of temperature. It will be remembered that Chauveau found a similar variation on the top of the Eiffel Tower. At the same time, the author observed the loss of electric charges, and found it to be some 30 per cent per minute for negatively-charged bodies, and 3 per cent per minute for positive ones. The results given by the author confirm and extend Elster and Geitel's laws, according to which the atmospheric conductivity increases with the elevation, and becomes more and more unipolar. The solar ionization theory is also confirmed. Of the ions produced by the sun's rays in the upper atmosphere, the positive ones, being less mobile, remain more in the upper strata, and bring about a preponderant negative dissipation from charged bodies.—G. Le Cadet, Comptes Rendus, April 6, 1903.

* Compiled by E. E. Fournier d'Albe in the Electrician.

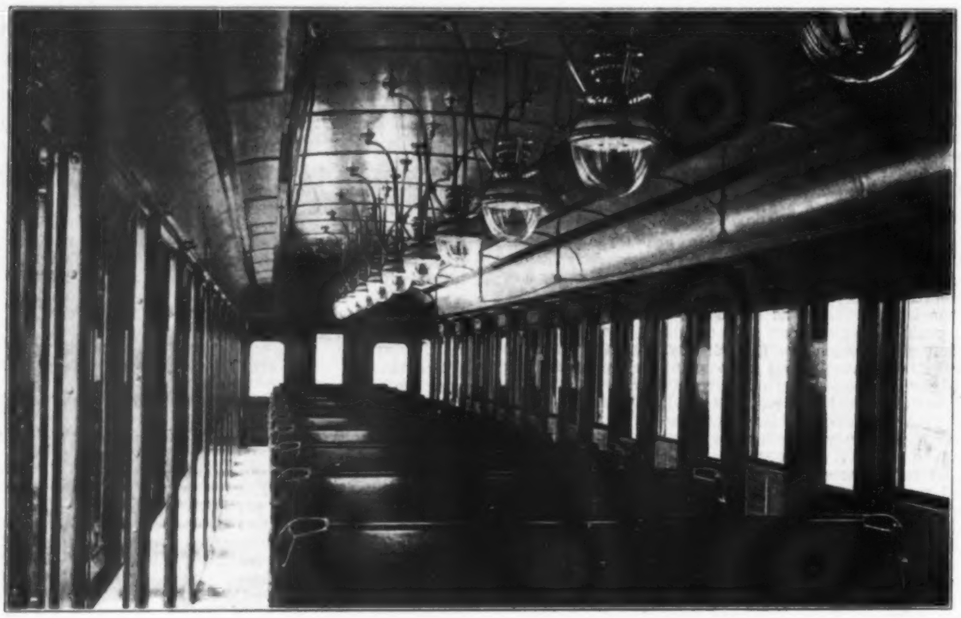
THE STEEL-FRAME SIDE-DOOR PASSENGER CAR BUILT BY THE ILLINOIS CENTRAL RAILROAD COMPANY.

THE unusual interest which attaches to the steel-frame side-door suburban passenger cars, recently put in service by the Illinois Central Railroad, is due not alone to the novel mechanical features developed in their design and construction, but even more to the effect this type of car is likely to have upon the question of the safe, rapid, and efficient transportation of a dense passenger traffic, and especially to the protection against fire resulting from the exclusive use of steel in the underframe. This question has become such an urgent one in all large cities that public interest is immediately concerned in any solution that offers intelligent and practical means of relief from the discomfort, distress, and dangers incident to the use of the end-door type of car of wooden construction, which, with all its other disadvantages, gives to the public the minimum of seating accommodation, with the slowest possible service in receiving and discharging passengers.

The Illinois Central Railroad has the largest suburban traffic of any railroad in America. During the World's Fair at Chicago, in 1893, it transported safely and with marvelous dispatch nineteen million passengers during the few active months of the World's Fair season, mostly in side-door cars. The experience then gained has been applied to the improvement of its regular service; and it is now introducing a steel-frame side-door car with wide vestibules, with a view to facilitating the loading and unloading of its trains.

The side-door car of the Illinois Central is quite unlike that used on English railroads, not alone in the details, but in the principles of its design. Instead of the swinging compartment doors of the English cars, each one of which has to be opened and closed separately, sliding side-doors are used, which are operated and controlled by ingenious mechanism within the walls of the car, so that all the doors may be opened and closed together or separately, as occasion may require, by the trainman in charge of the car. This arrangement admits of the instant and perfect control of all the doors from either end and both sides of the car, effecting great saving in time over the swinging door method.

Next to the sliding door, the abolition of the interior compartments and the opening of side aisles are the most noticeable differences, affecting not only the appearance, but the use of the car. In English practice, when a train arrives, the passengers to take it must go along the station platform, looking into first one compartment and then another until vacant seats are found, this proceeding consuming much time and greatly delaying the train. By the use of aisles extending the entire length on both sides of the car, as in the new cars, the passengers may enter at once any of the side-doors, and if vacant seats are not found immediately at the entrance, they can pass along the aisles to other parts of the car, or if necessary, through the communicating end-doors of the vestibules to other cars where seats may be found; the train meanwhile having resumed motion, no time is lost waiting for passengers to find seats.



INTERIOR VIEW OF CAR, SHOWING SIDE AISLES.

The remedy for delay in rush hours of traffic, usually applied, of increasing the number of trains at such times, does not afford the desired relief, for the reason that no improvement can thus be effected in the crowding of passengers at the ends of the cars, with the incidental surging, struggling efforts of many persons to gain immediate entrance through the narrow gateways and end-doors. In these circumstances it is evident that the remedy lies in preventing the formation of the crowded groups at the ends of cars, and of distributing the passengers evenly over the entire length of the station platform, so that when trains arrive they may step directly and conveniently from the platform to the side-doors of the cars, and avoid the uneasy movement up and down the platform to get opposite the end entrances at their more or less uncertain points of stoppage. Such distribution can be effected only by the use of cars having a sufficient number of side-doors, so that there is no choice of position on the station platforms when awaiting trains. This result is obtained in the new cars, which have twelve sliding side-doors on each side spaced five feet from center to center throughout the length of the car, each door being directly opposite a section of eight seats, with aisles on both sides just inside of the doors extending the entire length of the car.

This new type of car is the result of careful study, based upon long experience in the handling of a large suburban traffic on the part of Mr. A. W. Sullivan, Assistant Second Vice-President, and of Mr. William Renshaw, Superintendent of Machinery, of the Illinois Central Railroad, to whom we are indebted for our photographs and particulars.

The under frame of the car consists of four 9-inch by 21-inch steel I beams, 64 feet in length, spaced nearly equal distances apart and of a total width over the flanges of 10 feet, 4 inches. The end sills are 9-inch by 25-inch steel channels set with backs to the squared ends of the longitudinal sill, and riveted to them with double angle plates reinforced by gussets. Four truss rods passing over the inner body bolsters and anchored to the outer body bolsters, are used to support the middle of the car. These rods are solid, that is, without the usual swivel connection in the middle; their adjustments being obtained by eight vertical screw queen posts resting with their lower ends upon the rods and their upper ends supporting two steel needle beams of 7-inch by 15-inch I beams extending entirely across the car under the sills, with their upper flanges riveted to the lower flanges of the sills, thus bracing as well as supporting the underframe.

Over the body bolsters and over the needle beams, 6-inch by 12¼-inch I beams in short sections are placed between the longitudinal sills as stiffening members and riveted with angles to the webs of the sills.

Upon the metal sills, a steel floor of ¼-inch plates, 60 inches in width, is laid with butt joints formed by the planed edges of the plates and extending entirely across the underframe. This floor is riveted to the upper flanges of the sills with double rows of ½-inch rivets. There is thus obtained a continuous metal surface extending the entire length and width of the car, insuring perfect rigidity of the underframe and giving complete protection from fire underneath the car.

The underframe is carried upon four body bolsters made of 7-inch by 1-inch steel bars in the upper and lower members. The bolsters are arranged in pairs, 4½ feet centers, and bolted to the lower flanges of the sills. Heavy truss connections extend between the bolsters, to which are bolted the center plates.

The upper frame is constructed of 3-inch by -inch steel channels with solid-forged ends, which are riveted at the bottom to the top flanges of the side sills, and at the top to an iron plate, 4½-inch by ½-inch, which extends in one piece throughout the length of the car and the vestibules. The channels are spaced to form the window and door posts, and are set back to back 2 inches apart so as to form hollow side walls, within which the doors slide when opened and closed. The corner posts consist of two 4-inch by 5¼-inch channels set transversely on the side sills and spaced 11 inches apart. On the outside and inside of these posts four triangular gussets of ¼-inch by 15½-inch steel plate are riveted to the flanges, tying them firmly together; the corner posts are riveted securely to the side sills and to the upper plates with angle connections. The space between the corner posts and the adjoining side-door posts is braced with a double set of diagonal bracing, formed of 1¼-inch angles in three vertical panels and riveted to the gusset connections. This arrangement of corner bracing gives stability to the upper frame and forms a collision bulkhead of great resistance.

The seats are of an entirely new design, in bench form, arranged transversely in sections, each section seating eight passengers. They are constructed throughout of mahogany, with straight backs 42 inches high, provided with swell panels for back rests. No upholstering is used. The seat bottoms of solid mahogany are of molded form, mounted on trunnion bearings in front and supported on springs in the rear, each passenger having an independent seat separated from adjoining seats by short arms. There are twelve sections of seats, with two additional seats at each end of the car, making a total of 100 seats.

Between the seat ends and the walls on each side of the car is an aisle 18 inches in width, extending the entire length of the car, connecting with the vestibule area and affording a passageway on both sides throughout the length of the train.

Opposite each section and directly in line with the section aisle is a side-door on both sides of the car, making a total of 24 side-doors, 12 on each side. The doors are mounted at the top on ball-bearing rollers and slide in and out of the spaces in the walls of the car. The thresholds are flush with the floor, equipped with safety treads and grooved to receive the lower ends of the doors. The side-doors are connected by mechanism concealed within the hollow walls of the car, and arranged to be operated in series by compressed air or by hand. The controlling mechanism is located at the ends of the car and is operated by the trainman. The mechanism is arranged so that the doors can be operated by either of two systems—that of the positive opening, closing, and locking of all the doors on a side at one time, or the closing, locking, and unlocking of all the doors at one time, leaving the opening of such doors as are to be used to be done by the passengers from either the inside or outside of the car.

ILLINOIS CENTRAL RAILROAD STEEL-FRAME SIDE-DOOR PASSENGER CAR, WITH DOORS OPEN.

THE VICKERS-MAXIM DISMOUNTABLE GUN.

THE English firm of Vickers' Sons & Maxim has recently brought out a 12½-pound dismountable gun for disembarkations and mountain service which is characterized by an extra light tube reinforced in front by a wide hoop, and in the rear by a winding of steel wire. Since so light a gun might exert too violent reactions upon the carriage, it is provided with a jacket designed to diminish the velocity of the recoil. In this way, the English engineers have succeeded in making a gun formed of two parts, the weight of which is as reduced as possible, and yet which is capable of firing a 12½-pound projectile at a velocity of 1,438 feet a second.

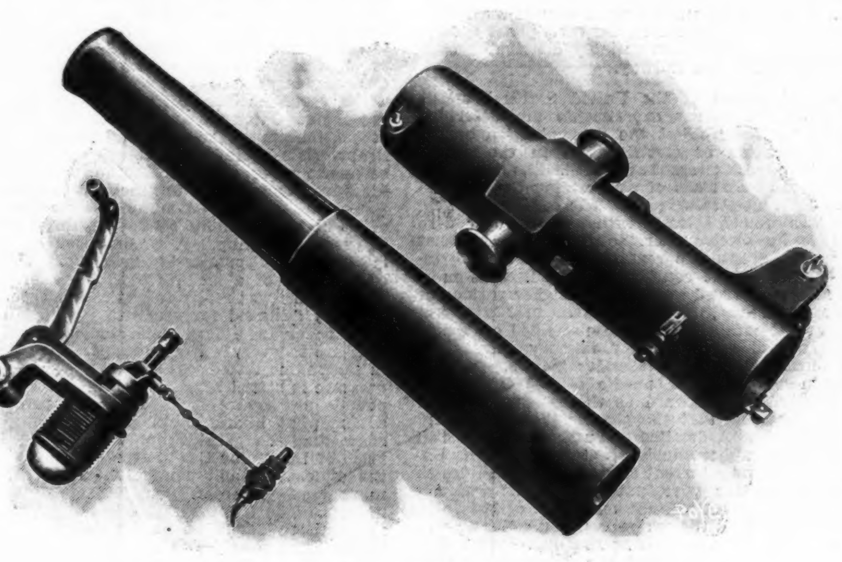


FIG. 1.—THE VICKERS-MAXIM GUN DISMOUNTED.

Progress has manifestly been made in power, since the similar 3-inch mountain gun of the French artillery throws a 14-pound shell, but with a velocity of only 816.7 feet a second. Even the German and French 3.75 and 3-inch campaign guns show hardly any greater ballistic superiority, since the first fires a 15-pound projectile at a velocity of 1,525 feet a second and the second a 13.75-pound shell at a velocity of 1,607 feet.

The Vickers-Maxim dismountable gun consists of three parts—the tube, the jacket, and the breech mechanism. The tube is formed of the several parts enumerated above, viz., the long interior tube, wide ring on front end, steel wire winding on rear end, that reinforces the rather thin tube. The jacket has trunnions and lugs for the breech-block pivot, while within it, on its front end, is a shoulder upon which the tube bears.

In order to mount the gun, the tube is introduced into the jacket through the rear until a contact with the shoulder ensues. Then, in the rear of the jacket, is screwed a nut designed to keep the two pieces in absolute and hermetical contact. The breech-block screws into this nut in order to close the gun. The dismounting of the gun is done by contrary means, as follows: The breech-block is first removed, the closing nut then unscrewed, and the tube withdrawn from the interior of the jacket, which is held immovable.

The breech closing is of the Welin system, that is to say, composed of six sectors, two blank and four threaded—the latter of different diameters and arranged in steps. The horizontal movement of a lever turns the breech-block the sixth of a revolution necessary to free it and cause it to open. The plastic obturator of the Bange type extends beyond the joint of the nut with the tube. This joint is thus protected against the action of the powder gases, which is a feature not found on other guns of this type. The firing is by percussion and on the safety system, so that the ignition of the charge can take place only when the breech is completely closed. The gun carriage is of metal, and consists of two cheeks connected by crossbraces. The pointing screw and axle are dismountable. A drag bearing against the lower part of the wheel felly and the butt end of the carriage permits of limiting the recoil. The carriage is coupled to limbers carrying two ammunition boxes, each containing twelve charges and twelve projectiles. The dismountable gun may be carried either by men for disembarkations or on muleback for mountain service. For carriage by men there are seven loads requiring two men each: (1) The gun tube; (2) the jacket and breech plug; (3) the carriage; (4) the breech mechanism, pointing screw, brake, cords, swab, pointing lever, etc.: (5) carriage axle; (6) carriage wheels; (7) ammunition boxes. The total weight to be carried is about 1,200 pounds, and the different loads vary between 120 and 220 pounds.

The carriage by muleback comprises five loads, thus distributed: (1) Tube and tools; (2) jacket, nut, breech mechanism, pointing screw, and swab; (3) carriage, spare tools, and pointing lever; (4) axle, wheels, and carts; (5) ammunition boxes. Taking into account the weight of the mules and harness, the total weight to be carried is 1,500 pounds. The weight of each load varies between 268 and 340 pounds.

Such weights are somewhat excessive for the men as well as for the mules, especially when we consider that the piece is designed to be employed for colonial service. Another criticism to be made of the new gun, which is so remarkable in many respects, is that it is not a rapid-fire one. This is a disadvantage that might limit its career, for it would seem as if rapid-fire guns are destined to be employed in the future almost exclusively, and that any weapon not possessing this quality will be of but little use in the warfare of the twentieth century.—Translated from La Nature for SCIENTIFIC AMERICAN SUPPLEMENT.

THE BIRD LIFE OF AUTUMN.

By FREDERICK A. OBER.

Now that the songs of our summer birds have mainly ceased, now that the wave of bird life that overspread the land in the spring is ebbing to the South, we cannot but be sensible of a loss, reparable only at the opening of another vernal season. The aerial hosts are assembling for their semi-annual flight, many summer visitants have already departed, and the advance pickets of flying columns are winging their way to Florida, Mexico, and the West Indies. The first to arrive in the spring are not always the first to depart, by any means, for some of them tarry till the latest flight comes down from the North, retiring slowly and reluctantly to make room for the winter visitors. Among the last to arrive from the South, in the northward migration, are those general favorites, the bobolink and golden oriole; yet they are among the very first to desert us. They arrive with the apple blossoms, at the earliest, and depart before the fruit has matured. Hardly more than three months have elapsed, and the pendent oriole nest in the elm tree is empty, having sent forth its brood of golden beauties; while as to Robert o' Lincoln, who arrives in livery of black and white and with a song fit to tickle the ears of the gods, he has long since changed his coat to one of more sober hue, and is now the unhappy "reedbird" of epicurean desire. He is sought in the marshes of New Jersey and southward, by so-called sportsmen of very low degree, the veriest pot-hunters taking part in the pursuit, until few of his family and name survive. How any one who has ever heard the rollicking stream of melody poured forth by the bobolink in springtime, can take the life of this inimitable songster at any season of the year, is more than I can comprehend. But nature has its compensations and works out its own revenges, for as Bob flies low o'er the marshes those out gunning sometimes get peppered with shot intended for him; and again, he has been the indirect means of establishing a use for that generally worthless British bully, the English sparrow. It is an open secret that many a "reedbird" or "ricebird" has been served nicely browned on toast, which in life would have been classified by the ornithologists as a *Passer domesticus*.

PREPARING A HUNT FOR THE BIRDS.

Although I live within a short distance of a tract of woodland inhabited by many songsters, the immediate environment of my house was not at first attractive to them, being without trees or shrubs. This deficiency I set myself to remedy, and in two or three years have been so successful that this season the number of feathered visitants has wonderfully increased. Always, of course, I have with me that pest of town and country, the English sparrow, whose nestings I have vainly striven to break up; but a more welcome resident was the little "chipping" sparrow, a quiet, inoffensive bird of timid and retiring habit. A pair of "chippies" built their nest and raised a brood in the woodbines sheltering our western balcony, attracted to my doorway by the crumbs thrown out for their especial benefit. They sang not, neither did they boast attractive plumage; but their very presence was a delight. A near cousin of theirs, also of unobtrusive coloring, but with most delightful song, was won within my gates by the same attention to his wants and has proved a source of pleasure all the past season through. This was the song sparrow, properly a resident of wood or pasture land, where he mainly dwelt and raised his family. Coming early in the spring, the song sparrow has stayed by us up to the present time, every morning until recently hopping timidly up to the doorstep for crumbs, and then flying to a near tree or shrub to pour out his soul in song. Three months of liquid melody he has given me, for such crumbs as I have thrown out to him, and it need not be said that I am his debtor.

Still another shy visitor, yet more timid than the catbird, was the cheewink, or to-whee bunting, whose cheerful cry announced his presence every morning. Along well into the summer, after I had become accustomed to the sight of dozens of birds at a time flitting through my garden, consisting of half as many species, I became aware of a bird different from any of the others, which at first I could not identify. And what is more, it came in the guise of a benefactor. All the birds were welcome, of course, all except the English sparrow, and all were rewarding me in various ways for my attentions. But this new bird performed a more signal service than any of the others, for, strange as it may seem, it devoured the potato bugs.

AN ENEMY OF THE POTATO BUG.

These noxious bugs were already so numerous that I was thinking of treating them to a drastic dose of Paris green, when one morning I noticed the new bird at work upon them. In a week or so it had entirely cleaned out the bugs, and then, apparently having no further use for my garden, it disappeared. But not before I had obtained a good view of it, though it was extremely shy, and found, to my astonishment, that I had, indeed, been entertaining an angel unawares. It was, in fact, one of the noted beauties of our American avifauna, no less than the rose-breasted grosbeak, that had condescended to leave its retreat in the deep forest and perform for me such a service as no other bird had performed before. Had I not seen it frequently, and repeatedly verified my observations, I should not have believed the evidence of my eyes. But there is scarce a bird in the eastern United States with which I am unacquainted, and I am sure that this new destroyer of potato bugs was none other than the grosbeak. Very early in the spring I constructed a bird-house, a box-like, double-decker affair, which I perched in the crosstrees of a double row of bean poles above my garden walk. It had hardly been placed in position before a pair of bluebirds inspected it, and, to my great delight, nesting arrangements began without delay. One or the other of the birds was busily at work, bringing sticks and straws, until the nest was completed, and during this time, all through the period of nidification, I was treated to as pretty a picture of bird life as one could desire. The male generally perched upon a bean pole or clothes line, close to my doorway retreat, where he warbled to his heart's content, and very much to mine also. His oft-repeated, soft, and pleasing warble, interrupted by sudden dashes after food, in shape of grub or grasshopper, continued through the months of April and May, and at the beginning of June there were signs of eventful happenings in the bird house.

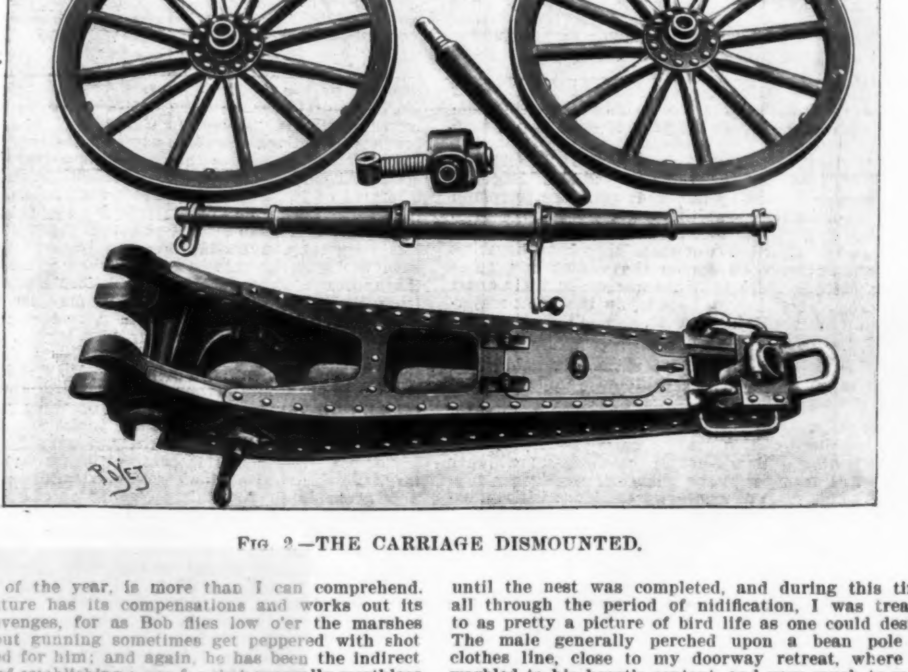


FIG. 2.—THE CARRIAGE DISMOUNTED.

Mr. and Mrs. Bluebird were excitedly happy when their progeny finally came forth, essaying their first flights to the near trees and shrubs, and I was correspondingly depressed at the prospect of their departure. In a day or two, of the first week in June, the box was empty, and I sorely missed my friends, who left behind a void no other birds have filled. They came back at intervals during the next two weeks; but though the old ones inspected the house in a tentative manner and fought away the assembled sparrows, as if bent upon reoccupying their home, they never did so.

A NEW TENANT.

They had hardly abandoned the field, when I noticed another visitor examining the premises. This new arrival was the bird, of all others, I would have chosen in their place, for it was a wren, a rare visitant of my particular neighborhood. Perhaps there is no other species so generally distributed throughout the Middle and New England States as the wren, and yet so irregular in its distribution, being plentiful in some localities and in others adjacent being rarely seen. However, there he was, sprightly and saucy, running up and down the bean poles and in and out the bird-house, with an unmistakable air of being thoroughly at home from the first. But he was alone, and for nearly a month enlivened the garden with his song before another appeared. Then, about the first week in July, his persistence was rewarded by the coming of his mate, and the two set about filling the upper compartment of the box with small sticks, and seemed bent upon housekeeping. So I was consoled for the absence of the bluebirds, especially as the song of the wren is more joyous and insistent than that of his predecessors, and the male rent the air with it from earliest morning until dusk. But no sooner had the little bride settled herself to her satisfaction than I noticed the songs had ceased. I at first attributed the fact to a possible desire on the part of Mr. Wren to attract as little attention as need be to his domicile, especially as he and his mate had been the objects of hostile demonstrations by the English sparrows. These latter would assemble in flocks of half a dozen or so, and, without actually attacking the small but pugnacious songsters, would finally bulldoze them into quietude. Whether at last they succeeded in driving the wrens away, or whether the latter distrusted the condition of the poles that supported the house—which were rather shaky, I must confess—at all events, the wrens departed, and I have not seen a feather of them since the first of August. But I shall do all in my power to induce them to return next season, by building a brush heap in a corner of the garden, and encouraging the advent of spiders and other insects upon which they feed. They shall also find, unless my plans miscarry, a more substantial bird-house constructed especially for them, and perched upon an arbor with stout posts. It was too bad that both bluebirds and wrens should have left the house before it became covered with the scarlet runners and wild cucumber vines which later draped it and the poles in graceful festoons, for, insecure as it seemed, at all events it was beautiful. It vied with the adjacent "wigwam" in beauty, the poles composing which, so bare and ugly in June, are now hidden beneath a wealth of greenery from the lima beans and scarlet runners.

Well, nearly all the garden songsters have departed, among the last to linger being the song sparrows; but the place has been redeemed from actual desolation by the advent of the goldfinches, attracted to it by the rows of sunflowers, which I planted for that very purpose. Some there are, I know, who begrudge the birds the seeds and fruits they chance to pick up in their gardens; but I am not of that number. On the contrary, I made the robins especially welcome to my cherries, currants, and strawberries, only regretting there were not more and various fruits to attract them; while as to the sunflowers, though their great golden disks gleam and glimmer wondrously above my corn and potatoes, the goldfinches may destroy every one, if they like, only provided they will continue to favor us with their visits. I love to trace their peculiar, wavering flight against the sky, to watch them as they cling to the sunflowers, head downward, and listen to their sweet notes. The robins have long since left the lawns and may be seen scurrying across the fields, high up, and with rapid flight, as if aware that, but for the strictly enforced game laws, they would become the prey of the "Dago" with his gun.

The white-breasted swallows have suddenly appeared, of late, out of their mysterious breeding places, and assembled by hundreds upon the telegraph and telephone wires; but they have no song, though their vast utility is shown by the millions of insects they destroy. Multitudes of them have been hovering above the bayberry bushes on the vacant lots, some of them settling there in dense masses, in their quest for insects. They, too, will soon join the great majority of migrants.—Evening Post.

The Sulman-Teed process of extracting gold from its ores is also known as the bromo-cyanide process. It depends upon the chemical reaction

$$CyBr + 3KCy + 2Au = 2KAuCy_2 + KBr.$$

The inventors of this process claim for it that it is superior to the ordinary cyanide methods in the higher potential of cyanogen. The quantity of cyanogen bromide in solutions is determined by mixture with an excess of potassium iodide, and acidification with hydrochloric acid, during which iodide is liberated as follows:

$$BrCy + 2HI = HBr + HCy + 2I.$$

The amount of iodide is determined by the use of sodium thiosulphate in the usual manner. A plant employing the Sulman-Teed process does not differ from the usual type of cyanide plant. The solution is made up in a single tank, containing about 7 per cent bromide cyanogen, which is added to the ordinary KCy solution, but an excess must be avoided, as potassium bromide is decomposed during its passage through the zinc. The amount employed should not exceed one-fourth the weight of potassium cyanide present.—Mining and Scientific Press.

ELECTRICAL NOTES.

The electric working of the railway line between Gallarate and Milan has been so successful that the system is to be extended to other branches. The length at present worked electrically is 48½ miles. There are from 70 to 80 trains per day, 12 of which make the run from end to end in 77 minutes, inclusive of stops. The continuous-current system is used, and the motor cars run daily between 250 and 280 miles each. The express trains on the 25-mile section between Milan and Gallarate take only 30 minutes for the run. Power is obtained from a central station at Tornavento, and distributed on the three-phase system to a number of sub-stations suitably distributed over the whole length of the railway.

In a recent report of the United States Weather Bureau some interesting experiments are described which had for their object the determination of the normal distribution of electrification in the atmosphere. The investigators have used, like Franklin, a special kite as a means of determining the electrification of different strata in air. The cord which held the kite was wound spirally with a fine copper wire attached to an electrometer, so that, by the usual optical methods, accurate readings of the electric intensity at any height could be obtained. The most notable results recorded are that the higher regions of the atmosphere—viz., from 7,600 feet to 12,300 feet above sea level—are always in an electrified condition, and that the electric intensity is very greatly increased during showers or thunder storms. In perfectly calm weather the needle of the instrument moved forward or backward as the kite rose or fell in the air, showing that the electric intensity varied with the altitude. A detailed account of the electrical state of the atmosphere during a storm is given. Under such conditions a torrent of sparks could be drawn from the conducting wire, but the current was not enough to light up an incandescent lamp of 105 volts. In other experiments the water-dropping collector was used, especially in investigating the distribution during a thunderstorm. Here, at one moment, the electrometer would show that the amosphere had a strong positive electrification; this would increase until a flash of lightning occurred, when the needle would oscillate violently, finally showing a strongly negative condition. The intensity of electrification at any one point during a storm depends upon its distance from the storm area. The constant existence of some electrical condition in the atmosphere lends interest to inquiries as to the extent of the earth's electric field. Investigations at the highest altitudes it is at present possible to reach seem to show that the upper limit is in the area between 10,000 feet and 15,000 feet above sea level. Above this area the electric potential may be regarded as constant. The cause of this phenomenon has not yet been satisfactorily elucidated, and various theories have been brought forward to account for it. These all agree in regarding friction between particles of the same or different materials, such as water and air or water and ice, as the initial cause. These researches seem to indicate that the impact of rain on the surface of a lake or sea, or even the wind blowing on these surfaces, produces electricity, which may be the initial cause of thunderstorms.

An interesting instance of the rapid extension of the use of electricity is furnished by the fortifications distributed along our coast. A few years ago the electric light was introduced to add to the comfort of the garrisons and to provide better illumination of the works. Once a generating plant had been installed, there was at hand a supply of power in a convenient and easily controllable form, and this led to its use for purposes which were not contemplated at the time the plant was installed. Electric fans have been put in to make the living quarters more comfortable in hot weather, and electric motors have been adopted for training the guns, a class of work for which they are particularly well adapted. Motors are used to drive the ammunition hoists and to do other work which before had either been done by hand or some less satisfactory power. Searchlights have been installed, enabling a fortification to sweep the sea at night. The various posts of the fortress are connected together by telephone, so that the commandant is in touch at all times with the entire garrison, and can instantly transmit orders to any point. The various fortifications along the coast are tied together by telephone and telegraph, so that on the appearance of the enemy at any point all the fortifications would be informed of it. Submarine mines are controlled electrically, and even the guns may be fired by this means, by an officer at some distant point. By means of wireless telegraphy, a fortification can be kept in touch with the scouting vessels, and would be informed of the approach of the enemy long before he is visible from the coast. The telautograph may be brought into service for transmitting orders, and electric signaling lights are replacing the older types. Electric lights are used for range-finder crosshairs, for lighting the range-finder stations; and electric clock circuits furnish accurate time to all parts of the fortification. To insure the continuity of these manifold services, accumulators are now installed, so that there will at all times be a constant and reliable supply of power. Thus, from being at first a small auxiliary, the electrical equipment has extended until it is now probably the most important part of the entire equipment of the fortress. While, of course, the intention of the fortress is primarily to provide a suitable place for the coast guns, the guns themselves would be useless unless means were provided for handling and operating them. The electrical equipment has become the controlling factor, for it not only trains the guns and fires them, but transmits the order to fire. It is found in the fortress in nearly all of its applications, and for its proper management men are required who are skilled in all branches of electrical application. It furnishes an instructive example of how quickly a new agent may be employed for an old work, and how its success in one application leads to its further use, until it drives from the field all rivals.—Electrical Review.

ENGINEERING NOTES.

The engines fitted to motor cars are rated by some makers at powers which could only be obtained if the mean pressure during the working stroke was 120 to 150 pounds per square inch. We have always had great hesitation in accepting these figures, although assured by the makers that the actual powers stated have been recorded on the brake. Even in the Korting gas engine, where the compression is 125 pounds per square inch, and the maximum pressure about 400 pounds per square inch, the mean effective pressure on the piston is only 90 pounds per square inch. Further, the motors supplied to the North-Eastern Railway Company for their Hartlepool service, which were rated at 100 horse power, have, it is reported, proved quite inadequate to the requirements of the traffic. These considerations all point to the conclusion that the engines fitted by some motor car makers yield in actual fact much below their nominal horse power. Brake trials by independent experts would, of course, settle the matter; but until authoritative figures of this kind are published we are inclined to the opinion that the actual power of a motor car or motor bicycle is often not much more than one-half to two-thirds of its nominal rating. A confirmation of this opinion is afforded by some tests made by M. E. Hospitallier on a motor of a leading French maker. The object of the trials was really to test a new type of indicator specially designed for use with very small and quick-running engines, for which indicators of the usual type are in every way unsuitable. The working agent in the engine tested was carbureted alcohol; the mean pressure is stated by M. Hospitallier to have been 61.8 pounds per square inch. No doubt petrol may yield a somewhat higher mean pressure, but brake trials show that the gain is not very great. In a recent issue of the Motor Car Journal we find a table giving the dimensions and nominal horse power of a large number of motor car engines by different leading makers. The differences are extraordinary, the maximum piston displacement allowed per nominal horse power being nearly two and a half times as much as the smallest. The average piston displacement (reckoning out-strokes only) is 173 liters per nominal horse power minute, which corresponds to a mean pressure of 75 pounds per square inch in the cylinders. With the highest rated engine the mean pressure would be 115 pounds per square inch, a figure which, for reasons stated above, we are by no means inclined to accept. M. Hospitallier, who has experimented a good deal with motors of this type, suggests that 200 liters piston displacement (out-strokes only) should be allowed per nominal horse power, and the mean pressure corresponding to this is about 65 pounds per square inch.

The method of testing indicator springs at the Reichsanstalt is as follows: The springs are tested in the cold and hot, chiefly after the methods described by Slaby, with the aid of a glycerine force-pump, and a small steam-boiler. The piston is either very carefully loaded to avoid any vibrations on increasing or decreasing the pressure, or vibrations are set up purposely. Slaby himself has found that the method somewhat influences the scale; this influence is observed to be small, and the deviations are probably as much due to differences in the steel, in its hardness and torsion, not to speak of friction, lateral bending, and other disturbances, as to the method of applying the pressure. In the hot state, however, springs which operate normally in the cold may not be equally reliable on ascending and descending curves. But these irregularities disappear as the intervals between diagrams decrease. The temperature differences between the steam, the spring chamber, and the spring itself, as tested in its various portions, do not appear either to be so great as had been assumed. Using both mercury thermometers and thermo-couples of copper and constantan, Wiebe and Schwirkus have found that the temperatures of the springs remained on an average about 11 deg. C. below that of the steam, whose temperature varied between 100 and 200 deg. C., and that the spring chamber was again about 5 deg. cooler than the steam. The middle portion of the spring is generally several degrees colder than its ends. Yet it is considered that these latter differences can be neglected, and that mercury thermometers are sufficiently sensitive for such work. Higher differences take place, however, when the indicator cocks are open during the experiment, because cold air then gains access. It was found further, from measurements made on a recording indicator fitted to an engine, that while the steam pressure varied in the high-pressure cylinder by about 100 pounds, which should correspond to temperature fluctuations between 120 and 150 deg. C., the temperature of the indicator spring remained constant at 103 deg. C. only. In the low-pressure cylinder the spring marked 113 deg. C. when it should have been 115 deg. C. according to the previous experiments. The length of the steam ports had nothing to do with these peculiarities, nor was there any faulty insulation. It is clear, therefore, that the temperature of the spring does not simply depend upon the average steam pressure. The indicator piston should fit tightly, and a suitable arrangement has been sketched out by the investigators. Very satisfactory tests have been made of the new indicators of Dreyer, Rosenkranz, and Droop, whose springs lie outside the indicator cylinder. The spring temperature did not rise above 54 deg. C., the surrounding air temperature being 43 deg. C. when the steam pressure was 10 kilogrammes (about 140 pounds), and natural air currents afterward kept the spring temperature constant at 54 deg. although the steam pressure was raised to 15 kilogrammes per square centimeter (213 pounds).—Engineering.

An approximate rule for determining the diameter of rivets is to extract the square root of the thickness of plate and multiply it by 1.25. The actual diameter of rivet may be varied slightly from the results secured by this rule in order to use standard sizes. For illustration, take a plate .5 inch thick, the square root of which is .71. Then .71 multiplied by 1.25 equals .8875 inch. The nearest standard size is ⅞-inch, which would be used in such a case.—Mining and Scientific Press.

TRADE NOTES.

Effervescent Mouth Wash is produced by maceration and subsequent percolation of powdered quillaia bark 60 grammes, with a corresponding amount of spirit of wine and 45 cubic centimeters of glycerin, adding 60 drops of bergamot oil, 60 drops of oil of wintergreen, and 10 drops of clove oil dissolved in 30 cubic centimeters of spirit of wine. Next add sodium salicylate, 775 grammes, and enough of a carmine solution to produce a nice red color. Filter through dry powdered stealite and add diluted spirit of wine to make up a total of ½ liter.—Pharmaceutische Post.

Waterproof Cardboard Cement.—To unite pieces of pasteboard in an inseparable manner, the following cement is recommended, which, outside of sufficient adhesiveness, also possesses the quality of being waterproof: Melt together equal parts of good pitch and gutta percha. To 9 parts of this mass add 3 parts of boiled linseed oil and 1-5 part litharge. The heat is kept up until, with constant stirring, an intimate union of all the ingredients has taken place. The mixture is diluted with a little benzine or oil of turpentine and applied while still warm.—Die Werkstatt.

Spirit Varnishes.—According to the Seifensieder Zeitung, of Augsburg, the following recipes have been found excellent:

Express Drying Varnish.—For painting furniture, models, wooden pulleys, etc., Manila copal (spirit-soluble), powdered, 40 kilos, pale American resin 20 kilos, thick turpentine 1 kilo, linseed oil varnish 1 kilo, are dissolved in spirit 75 kilos in a lukewarm place, allowing to settle. This lacquer may be colored as desired with spirit-soluble aniline dyes as well as with mineral colors.

Bookbinders' Varnish.—Venice turpentine 12 kilos and blond shellac 30 kilos, dissolved in spirit 90 kilos.

Picture Varnish consists of a solution of Venice turpentine 8 kilos, and sandarac 8 kilos in spirit 28 kilos.

Label Varnish.—Manila copal 15 kilos, Venice turpentine 4 kilos, gallipot 4 kilos. Dissolve warm in spirit 26 kilos.

Organ Varnish.—Consists of a solution of very fine bleached shellac 25 kilos, in spirit 75 kilos.

Sculpture Varnish.—Dissolve Venice turpentine 5 kilos and sandarac gum 6 kilos in 95 per cent spirit 20 kilos.

Can Varnish.—Dissolve shellac 15 kilos, Venice turpentine 2 kilos, and sandarac 8 kilos in spirit 75 kilos.

Ordinary Paper Varnish is prepared by dissolving sandarac 15 kilos and common, though pure, thick turpentine in spirit 45 kilos.

Transparent Varnish.—Dissolve 2 kilos of bleached refined shellac and 8 kilos of elemi in 9 kilos of spirit, shaking frequently.

Capsule Varnish.—Pour 26 kilos of spirit over bleached shellac 9 kilos, French pale resin 1 kilo, elemi 350 grammes, and camphor 100 grammes in a large bottle and let stand, with frequent shaking, in a temperate place 4 to 5 days. Color with any desired spirit-soluble aniline dyes.

To Mend Wedgwood Mortars.—It is easy enough to mend mortars so that they may be used for making emulsions and other light work which does not tax their strength too much. But a mended mortar will hardly be able to stand the force required for powdering hard substances. Good cements for mending mortars are the following:

1. Casein free from fat and washed until no longer acid, silicate of soda solution (water glass), of each ....q. s.

Fill a bottle to one-fourth of its height with damp casein, then fill the flask with silicate of soda (water glass), and shake frequently until the casein is dissolved. The casein should be made by curdling skimmed milk and well washing.

2. Glass flour elutriated 10
Fluorspar, powdered and elutriated........20
Silicate of soda 60

Both glass and fluorspar must be in the finest possible condition, which is best done by shaking each in fine powder, with water, allowing the coarser particles to deposit, and then to pour off the remainder, which holds the finest particles in suspension. The mixture must be made very rapidly by quick stirring, and when thoroughly mixed must be at once applied. This is said to yield an excellent cement.

3. Freshly burnt plaster of Paris........5 parts
Freshly burnt lime.......................1 part
White of egg.......................sufficient

Reduce the first two ingredients to a very fine powder and mix them well; moisten the two surfaces to be united with a small quantity of white of egg to make them adhesive; then mix the powder very rapidly with the white of egg and apply the mixture to the broken surfaces. If they are large, two persons should do this, each applying the cement to one portion. The pieces are then firmly pressed together and left undisturbed for several days. The less cement is used the better will the articles hold together.

4. If there is no objection to dark-colored cement, the very best that can be used is probably marine glue. This is made thus: 10 parts of caoutchouc or India rubber are dissolved in 120 parts of benzine or petroleum naphtha, with the aid of a gentle heat. When the solution is complete, which sometimes requires 10 to 14 days, 20 parts of asphalt are melted in an iron vessel and the caoutchouc solution is poured in very slowly in a fine stream and under continued heating, until the mass has become homogeneous and nearly all the solvent has been driven off. It is then poured out and cast into greased tin molds. It forms dark brown or black cakes, which are very hard to break. This cement requires considerable heat to melt it; and to prevent it from being burnt it is best to heat a capsule containing a piece of it first on a water bath until the cake softens and begins to be liquid. It is then carefully wiped dry and heated over a naked flame, under constant stirring, up to about 300 deg. F. The edges of the article to be mended should, if possible, also be heated to at least 212 deg. F., so as to permit the cement to be applied at leisure and with care. The thinner the cement is applied the better it binds.—Am. Druggist.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Food Stuffs and the French Market.—There seems to be a total lack of effort on the part of American exporters to introduce into France certain vegetable products which are very plentiful in the United States and are practically unknown here. I refer particularly to maize, groundnuts or peanuts, oats and wheat for table use, and sweet potatoes. I might also add American fresh fruits.

This part of France produces a yellow maize of a very inferior quality, used for feeding farm stock. Small quantities are ground for table use, but as the meal is poorly made and turns bitter eight or ten days after leaving the mill it is not only not a popular article of diet, but is the cause of a prejudice against maize as human food.

The fine quality of American granulated yellow corn meal is much appreciated in a very limited circle. The people generally know nothing about white and yellow corn meal, hominy, samp, and hulled corn, valuable and cheap articles of diet. The introduction of "johnnycake" to the French public might prove a profitable departure for the United States exporter.

What is said of maize for table use may be said largely of oats and wheat. Small quantities of Scotch oatmeal find their way to the larger towns, but, being generally unknown, it is not popular. Crushed or broken wheat is not used at all and has hardly been heard of.

The sweet potato is better known, but is not generally used, as the quantities received in this part of France are limited and the quality not of the best. Sweet potatoes come principally from Spain. Although I have traveled for several years in France and have consequently eaten at many hotels, I have never seen sweet potatoes either served or mentioned in the bills of fare. This article of diet, when of superior quality, would surely tempt the fine palate of the French public, and might become a lucrative business to American growers. In considering the best means of rendering popular the above-mentioned articles, it would seem that a lot of earnest and practical advertising should be done, and of this more efficient than the posters on the billboards and notices in periodicals would be an organized effort by which these edibles, properly cooked in various fashions, could be tasted in several stores in every large city.

The attempt to do this at Paris during the exposition of 1900 was a failure, as far as France is concerned, because the number of French people reached by this method was comparatively few. There seems to be absolutely no reason why the above-mentioned food products should not become popular dishes on French tables. As food, they are both healthy, cheap, and nutritious.

I should like also to mention in this place the American peanut, or groundnut. Immense quantities of these nuts are received in France from the west coast of Africa and are used to make oil. In some ports they are received in shiploads of 2,000 or 3,000 tons at a time. I do not know that any come from the United States. Roasted peanuts are rarely seen on the streets or in the shops for sale, and there are no peanut venders on the streets or at the grain fairs. The few that are sold roasted come from Spain principally, and are small in size and of inferior quality as compared with the American product.

Lastly, I wish to call to the attention of our fruit growers the fact that American fruits are scarce in France; I refer to dried, canned, and fresh fruits. American prunes and dried apples are in very strong favor, but the opportunities for placing our dried apples are still many.

California are tinned fruits are to be found in many large grocery stores; but as these fruits are unknown generally and dear in price, comparatively small quantities are sold. What is needed for the development of the trade in these goods, dried as well as canned, is direct relations, in order to avoid the large commissions which are lucrative to the agent to a certain degree but ruinous to the trade.

Concerning fresh fruits, there is very much to be done. Our apples, pears, peaches, and plums I have seen more or less plentifully in English cities; in France they are rare, even in Paris, and, outside of that city, practically unknown.—George H. Jackson, Consul at La Rochelle.

American Investments and Trade in France.—United States capital has found at Lille, as elsewhere in Europe, an important and extensive field in street railways. By means of this capital in the hands and under the control of American directors the whole of the Department of the North and the most important part of the Department of Calais are to undergo a widespread and beneficial transformation.

Lille is not only the industrial and commercial center of these two departments, but it is also the railroad terminus. The necessity of connecting these two departments with Lille, in view of business relations, has become imperative.

United States capitalists, incorporated under a French company, by granting certain concessions and by making important improvements, have obtained the right to construct a series of trolley car lines extending to all parts of the two departments and bringing the chief manufacturing districts into close connection with Lille, the center. The distance which these lines are to cover is about 850 miles.

In order to obtain this concession, with a lease of ninety-nine years, the corporation has contracted to build and lay out a large boulevard between Lille, Rouleaux, and Tourcoing. The cost of this boulevard has been estimated at $400,000.

The project was not carried through without many difficulties, owing to the fact that foreign capital is engaged. All obstacles, however, owing to the pressing need of the work, have given way to popular feeling, which is greatly in favor of the enterprise.

American Trade Agencies.—American capital finds easy way into this country, but American products do not. The enormous duties that are levied upon American articles in contradistinction to the more favored nations render it very difficult to place American goods upon the market advantageously.

In spite of these conditions, with perseverance and persistence an opening can be made for our products. Much will depend upon the manner of introducing them. The usual method employed by American manufacturers is to write to the consular officer for the names of firms likely to be interested in their articles offered for exportation. The consular officer as a rule furnishes as many names as possible, but the results are not always satisfactory. During the last fiscal year the above manner of introducing American-made goods has been entirely abandoned at Lille. Instead of sending a list of names to manufacturers at home, the interest of some reliable person likely to undertake the sale of the article proposed has been obtained. The manufacturer is immediately notified to that effect. He is asked to send conditions and samples. In the meantime arrangements are made with the persons interested here, and by the time conditions and samples arrive an agency is already established. By the attestations received from manufacturers this system may be said to have been successful. This manner of introducing goods can, however, be adopted only by consuls who are allowed to do business, as more time and expense are involved than could be afforded by other consular officers. At all events, it is a system with sure and permanent results.

During the fiscal year ended June 30, 1903, the following agencies were established at Lille for purely American products: Pine fiber; dried fruits, apricots, prunes, etc. (two agencies); refrigerators, shipping tags, desks (of which a large number have already been sold), diamond drills, machinery for artesian wells, etc.; and a few novelties.

Application has been received at this office for American cretonnes. It is the intention of merchants here to place this article on the French market.—C. J. King, Consular Agent at Lille.

Process Section at the Toronto Exhibition.—Publicity is given to the fact that one of the most interesting features of the new Manufacturers and Liberal Arts Building at the Dominion Exhibition to be held in Toronto, August 27 to September 12, will be the process section, in which twenty-seven different processes of manufacture will be shown in active operation. All these manufactures will include the very latest inventions in the different lines and on that account will be of the greatest interest, not only to Canadian visitors, but also to visitors from the United States. A few of the processes that will be on view are: Printing vast numbers of tickets by multiple press, bookbinding, and box making, all by the same firm; spectacle making, diamond cutting, glass blowing, die sinking, boot and shoe making, umbrella making, paint mixing, the manufacture of cotton and canvas bags, cotton spinning, elastic-stocking making, chain making, electric-light bulb blowing, button making, binder-twine making, electric welding, needle and pin making, flax spinning, soap making, metal spinning, carpet weaving, cloth making, broom making, and a variety of others, including the process of photogravure. These processes will be in constant operation and are expected to lend greatly to the attraction of the building.—E. N. Gunsaulus, Consul, Toronto, July 22, 1903.

Commercial Museums in Russia.—The British consul at Batum, in the British Board of Trade Journal of July 16, reports that in order to more successfully bring about a good understanding between Russian exporters and Persian Gulf merchants, and with a view to rendering the latter familiar with the diverse articles of Russian manufacture, the Russian Steam Navigation and Trading Company has decided to establish at Bushire and Bassorah permanent exhibitions of Russian industries, to be styled "Russian museums," where complete collections of products and articles of export manufactured by different firms in Russia will be exhibited, together with the f. o. b. prices labeled on them. The agents of the above company at Bushire and Bassorah have been instructed to organize museums of this kind in those towns.

Sale of American Furniture in South Africa.—An article in the Handels-Museum of June 25 calls attention to the opportunities offered for the sale of building material and furniture in Johannesburg, Transvaal, South Africa. The article emphasizes the demand for furniture and points out the popularity of American furniture, office supplies, etc., attributing the same to the fact that the articles furnished are suited to the tastes of the people.

Free Importations into Yucatan.—The Mexican Congress has passed an act extending the time for the free importation of such articles as were enumerated in the original decree of June 7, 1902,* into the newly created territory of Quintana Roo, Peninsula of Yucatan, for the term of one year from July 1, 1903, provided the articles mentioned are intended for consumption in that territory only.—W. W. Canada, Consul at Veracruz.

* For the original decree containing a list of articles admitted into the district named, see Advance Sheets No. 1396 (July 19, 1902) or Consular Reports No. 264 (September, 1902), page 118.

Index to Advance Sheets of Consular Reports.

The Reports marked with an asterisk (*) will be published in the Scientific American Supplement. The other Reports can be obtained by applying to the Bureau of Trade Relations, Department of Commerce and Labor, Washington, D. C. Since the number of Reports is limited, application for those which are desired should be made immediately.

SELECTED FORMULÆ.

Removing Stains From Marble.—

Soft soap	4 ounces
Whiting	4 ounces
Sodium carbonate	1 ounce
Water, a sufficient quantity.	

Make into a thin paste, apply on the soiled surface, and wash off after twenty-four hours.—Bull. of Pharm.

A Lotion for the Hands.—

Boric acid	1 drachm
Glycerin	6 drachms

Dissolve by heat and mix with

Lanolin	6 drachms
Vaselin	1 ounce

Add any perfume desired. The borated glycerin should be cooled before mixing it with the lanolin.—Bull. of Pharm.

Cologne.—An excellent formula for cologne is the one devised by Prof. Scoville and printed in the Bulletin of Pharmacy.

Bring into a glass vessel:

Alcohol free from fusel oil	7.9 gallons
Portugal oil	0.88 ounce
Rosemary oil	0.88 ounce
Lavender oil, bergamot oil, lemon oil, of each	1.76 ounces

After standing for 14 days, add 7.9 quarts of distilled water, mix thoroughly, and let stand until used.

Fertilizer for Garden Plants.—In the Druggists' Circular and Chemical Gazette, the following formulæ are published:

I.

Sugar	1 part
Potassium nitrate	2 parts
Ammonium sulphate	4 parts

II.

Ferric phosphate	1 part
Magnesium sulphate	2 parts
Potassium phosphate	2 parts
Potassium nitrate	2 parts
Calcium acid phosphate	8 parts

About a teaspoonful of either of these mixtures is added to a gallon of water, and the plants sprinkled with the liquid.

Glycerin and Cucumber Jelly.—

Gelatin	160 to 240 grains
Boric acid	240 grains
Glycerin	6 fl. ounces
Water	10 fl. ounces

Perfume to suit.

The perfume must be one that mixes without opalescence, otherwise it mars the beauty of the preparation. Orange flower water or rose water could be substituted for the water if desired, or another perfume consisting of:

Spir. vanillin (15 gr. per oz)	2 fl. drachms
Spir. coumarin (15 gr. per oz.)	2 fl. drachms
Spir. bitter almonds (1/4)	8 minims

to the quantities given above would prove agreeable.—Pharm. Era.

Rubber Cement for Patching Shoes.—

India rubber, finely chopped	100 parts
Rosin	15 parts
Shellac	10 parts
Carbon disulphide, q. s. to dissolve.	

This will not only unite leather to leather, India rubber, etc., but will unite rubber to almost any substance.

Caoutchouc, finely cut	4 parts
India rubber, finely cut	1 part
Carbon disulphide	32 parts

Dissolve the caoutchouc in the carbon disulphide, add the rubber, let macerate a few days, then mash with a palette knife to a smooth paste. The vessel in which the solution is made in both instances above must be kept tightly closed, and should have frequent agitations.—Nat. Drug.

Birch Balsam.—The Seifensieder Zeitung, of Augsburg, is authority for the following:

1. Alcohol	30,000 parts
Birch juice	3,000 parts
Glycerin	1,000 parts
Bergamot oil	90 parts
Vanillin	10 parts
Geranium oil	50 parts
Water	14,000 parts

Mix.

2. Alcohol	40,000 parts
Oil of birch	150 parts
Bergamot oil	100 parts
Lemon oil	50 parts
Palmarosa oil	100 parts
Glycerin	2,000 parts
Borax	150 parts
Water	20,000 parts

Mix.

Coloring a Meerschaum Pipe.—The simplest method of performing this is as follows: Fill the pipe and smoke down about one-third, or to the height to which you wish to color. Leave the remainder of the tobacco in the pipe, and do not empty or disturb it for several weeks, or until the desired color is obtained. When smoking, put fresh tobacco on the top, and smoke to the same level. Another method is as follows: The pipe is boiled for coloring in a preparation of wax which is absorbed, and a thin coating of wax is held on the surface of the pipe, and made to take a high polish. Under the wax is retained the oil of tobacco, which is absorbed by the pipe; and its hue grows darker in proportion to the tobacco used. A meerschaum pipe at first should be smoked very slowly, and before a second bowlful is lighted the pipe should cool off. This is to keep the wax as far up on the bowl as possible; rapid smoking will overheat, driving the wax off and leaving the pipe dry and raw. A new pipe should never be smoked outdoors in extremely cold weather.—Bull. of Pharm.

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